The Senate

Standing Committee on Rural and Regional Affairs and Transport

Climate change and the Australian agricultural sector

Final report

December 2008

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ABBREVIATIONS

AACC	Agricultural Alliance on Climate Change
ABARE	Australian Bureau of Agricultural and Resource Economics
ACCESS	Australian Community Climate and Earth Systems Simulator
ASCAS	Australian Soil Carbon Accreditation Scheme
APAL	Apple and Pear Australia Limited
Audit Advisory Council	National Land and Water Resources Audit Advisory Council
AWD	Available Water Determination
BoM	Bureau of Meteorology
BRS	Bureau of Rural Sciences
Climate Change in Australia	Commonwealth Scientific and Industrial Research Organisation and the Bureau of Meteorology: *Climate Change in Australia – Technical Report 2007*.
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
CO_2-e/ha/yr	carbon dioxide equivalent/ hectare/ year
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CCRSPI	National Climate Change Research Strategy for Primary Industries
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DCC	Department of Climate Change
EPPs	Emergency Plant Pests

ETS	Emissions Trading Scheme
FICT	Food Industry Council of Tasmania
the Framework	National Climate Change Adaptation Framework
GARA	*Greenhouse Action in Regional Australia* program
GDP	Gross Domestic Product
GHG	greenhouse gas
Green Paper	Department of Climate Change, *Green Paper on the Carbon Pollution Reduction Scheme*, July 2008.
MCVP	Managing Climate Variability Program
MLA	Meat and Livestock Australia
NACCAP	National Agriculture and Climate Change Action Plan 2006-2009
NAFI	National Association of Forest Industries
NCAS	National Carbon Accounting System
NCAT	National Carbon Accounting Toolbox
NFF	National Farmers' Federation
NSW	New South Wales
NWI	National Water Initiative
the Scheme	Carbon Pollution Reduction Scheme
UNFCCC	United Nations Framework Convention on Climate Change
WSP	Water Sharing Plan

Chapter 1

Introduction

Terms of reference

1.1 On 19 September 2007, the Senate referred the following matter to the Standing Committee on Rural and Regional Affairs and Transport for inquiry and report by 30 June 2008:

(i) the scientific evidence available on the likely future climate of Australia's key agricultural production zones, and its implications for current farm enterprises and possible future industries;

(ii) the need for a national strategy to assist Australian agricultural industries to adapt to climate change; and

(iii) the adequacy of existing drought assistance and exceptional circumstances programs to cope with long-term climatic changes.

1.2 On 14 February 2008, the Senate re-adopted the Inquiry with the terms of reference unchanged and with a reporting date of 4 September 2008. On 4 September 2008, the committee tabled an interim report, and indicated that a final report would be tabled on 4 December 2008.

Conduct of the Inquiry

1.3 The Inquiry was advertised in *The Australian* and through the Internet. The committee invited submissions from a wide range of interested organisations, government departments and authorities and individuals. The committee continued to accept submissions throughout the Inquiry.

1.4 The committee received 42 submissions. A list of individuals and organisations that made public submissions to the Inquiry together with other information authorised for publication is set out in Appendix 1. The committee held two public hearings in Canberra on 30 June and 1 July 2008. A list of the witnesses who gave evidence at the public hearings is set out in Appendix 2.

1.5 The committee also formed two subcommittees to undertake site visits to the Binnu district in Western Australia, and Warren in NSW. On 19 August 2008, a subcommittee visited the Binnu district of Western Australia for a site visit to 'Pine Crest', the farm of Murray, Jenny and Kyle Carson, which is being used to develop grazing and cropping systems using sub-tropical perennial grasses. On 12 September 2008, a subcommittee also visited 'Jedburgh' in Warren, NSW the property of Scott and Jo McCalman to see the work that is being done there in conjunction with the Australian Soil Carbon Accreditation Scheme. The committee accepted reports from the subcommittee, and has referred to these reports during its deliberations in the Inquiry.

The committee's final report

1.6 The committee's final report addresses two aspects of the Inquiry's terms of reference:

- the implications of Australia's likely future climate for current farm enterprises and possible future industries; and
- the need for a national strategy to assist Australian agricultural industries to adapt to climate change.

1.7 Chapter 2 of this report looks at the climatic implications of climate change for the Australian agricultural sector. Chapter 3 discusses some of the risks and opportunities that climate change presents to current and future farm industries. Chapter 4 of the report discusses some implications for the Australian agricultural sector arising from a proposed emissions trading scheme. Chapter 5 discusses the need for a national strategy to assist agricultural industries to adapt to climate change.

Acknowledgement

1.8 The committee thanks those organisations and individuals who made submissions and gave evidence at the public hearings. The committee would like to express its appreciation and thanks to those involved with the site visits: Murray, Jenny and Kyle Carson; Tim Wiley; Bob Wilson; Mike Bowley, Sam Harburg, Rob Grima and the staff at the Northern Agricultural Region of the Western Australian Department of Agriculture and Food; Chris King and Jane Bradley of the Northern Agriculture Catchment Council; Neil and Eve Eastough, Jim Wedge, Dale and Bruce Wynn, Don Nairn and Rowan Ford of the Northern Agri Group; Scott and Jo McCalman, Christine Jones, Rex Wilson and Ashley Wielinga.

Note on references

1.9 References in this report are to individual submissions as received by the committee, not to a bound volume.

Chapter 2

The impacts of climate change for the Australian agricultural sector

Introduction

2.1 The committee received many submissions and substantial evidence on the implications of climate change for the Australian agricultural sector. The potential impacts of climate change are diverse. Some impacts are direct, such as climatic changes to agricultural land, and others are indirect, such as the implications of government policy related to climate change.

2.2 This chapter begins with an overview of the Australian agricultural sector. The chapter then provides a brief discussion on the limitations of predicting the impacts of climate change. The chapter then discusses the implications for the Australian agricultural sector of specific climatic impacts of climate change. The discussion then moves to some of the broader implications of climate change, such as the impact on rural communities, the impact on biodiversity and how consumer expectations in relation to climate change issues will impact on the agricultural sector.

2.3 The opportunities and challenges that climate change impacts have on current and future farm enterprises are discussed in detail in Chapter 3 of the report. The committee received a substantial number of submissions and evidence outlining the impacts of an emissions trading scheme on the Australian agricultural and forestry sector. The committee considers these issues in detail in Chapter 4 of the report.

The Australian agricultural sector

Composition of the sector

2.4 The National Farmers' Federation (NFF) provided the following summary of the Australian agricultural sector's contribution to the Australian economy:

> The agricultural sector, at farm-gate, contributes approximately 3% of Australia's total Gross Domestic Product (GDP). However, when factoring in the value-adding activities that occur to farm outputs post farm-gate, and the value of all the economic activities supporting farm production in the farm-input sector, agriculture has averaged a contribution of 12.1% of GDP (approximately $103 billion in 2004-05 dollar terms) in the six years ending 2003-04. Australian agricultural exports are valued at approximately $30 billion annually, accounting for around one fifth of Australian merchandise exports.
>
> In addition, there are currently 308,000 people directly employed in Australian agriculture. However, the complete agricultural supply chain,

> including affiliated industries, provides over 1.6 million jobs to the Australian economy (1-in-6 of all jobs).[1]

2.5 The Australian Bureau of Statistics summarised the main industries comprising the agricultural sector for the period 2006-07 as follows:

> … the number of agricultural businesses at 30 June 2007 had fallen by 3% to 150,403 [since 1 July 2006].
>
> The beef cattle farming industry was the largest, with around 30% of all agricultural businesses. The mixed farming sector (grain-sheep/beef cattle) was the next largest with around 9%, followed by sheep farming with 8%.[2]

2.6 In terms of the gross dollar value, the NFF's website states that the top three agricultural commodities produced nationally are: cattle and calves; milk; and wheat.[3]

Vulnerability of the Australian agricultural sector to climate change

2.7 A number of submissions highlighted the vulnerability of the Australian agricultural sector to climate change. For example, Mr Ian Bowie's submission cited work by the Australian Bureau of Agricultural and Resource Economics which indicated that while agricultural production would decline globally, some of Australia's major competitors may not be as challenged by this as Australia.[4] Similarly, the submission of Meat and Livestock Australia highlighted the vulnerability of the Australian agricultural sector to climate change:

> Projections indicate that relative to other developed countries, Australia is exceptionally sensitive to climate change and agriculture is one of the most vulnerable sectors due to the impacts on productivity of changes in water availability, water quality, temperature, and pests and diseases.[5]

2.8 The committee also notes the assessment of the Garnaut Climate Change Review of the vulnerability of various subsectors of the agricultural sector to climate change, particularly the irrigated sheep, dairy and cattle industries with a very high vulnerability to climate change.[6]

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1 *Submission 24*, p. 3 (references not included).

2 Australian Bureau of Statistics, *Agricultural Commodities, Australia 2006-07*, May 2008, p. 4.

3 National Farmers' Federation (NFF) website, *Farm Facts*, http://www.nff.org.au/farm-facts.html, accessed 21 October 2008.

4 *Submission 2*, p. 2, citing Australian Bureau of Agricultural and Resource Economics, *Australian Commodities*, Vol. 14, No. 4, December quarter 2007, pp 657-676.

5 Meat and Livestock Australia, *Submission 36*, p. 2 (references not included).

6 Professor Ross Garnaut, *Garnaut Climate Change Review: Final Report*, 30 September 2008, p. 535. In this assessment 'vulnerability' is a measure of exposure, sensitivity and adaptive capacity of an industry.

The limitations of predicting the impacts of climate change

2.9 The committee's Interim Report summarises regional climate change projections from *Climate Change in Australia*, a joint project of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM).[7] The committee noted in its Interim Report that there is some uncertainty in making climate projections, and that there is ongoing work to produce long-term climate projections on a global and national scale. The committee also noted the need for further work to be done to downscale climate change projections to a local level to be of greater use to farmers in decision-making.[8]

2.10 The CSIRO made the following qualification in its submission about how this uncertainty in projections impacts on the reliability of predicting the impacts of climate change:

> While there are some general principles about how impacts of climate change will vary geographically, regional indications of climate change impacts are highly uncertain … regional climate change projections are currently more useful for describing the wide range of uncertainty and for probabilistic risk assessment than serving as reliable predictors for planning and decision making.
>
> The comments [in the CSIRO's submission] should therefore be used as an indication of the likely range of impacts for which primary industries will have to prepare, and NOT as a reliable predictions of exactly where specific impacts will occur.[9]

2.11 In its Interim Report the committee acknowledged the frustration that this type of uncertainty can cause for those in the agricultural sector.[10] However, with these limitations of current climate projections in mind, the committee is of the view that the information available on future climate is sufficient, in any case, to provide the foundation for discussion about the potential implications of climate change on the Australian agricultural sector.

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7 Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM): *Climate Change in Australia – Technical Report 2007* (*Climate Change in Australia)*.

8 See Senate Rural and Regional Affairs and Transport Committee, *Climate change and the Australian agricultural sector: Interim report* (Interim Report), September 2008, Chapter 2, and specifically pp 5-6, on the issue of the uncertainty of climate change predictions and pp 10-11 on the need for downscaling of climate projections.

9 *Submission 32*, pp 6-7, emphasis in original.

10 Interim Report, p. 13.

Climatic impacts of climate change

2.12 The CSIRO's submission provided an extensive description of the likely range of impacts of climate change, by region and by agricultural industry.[11] The Queensland Government and the Victorian Department of Primary Industries also provided the committee with detailed information on the impacts of climate change on the specific agricultural industries in those states.[12] Industry organisations also made submissions to the committee setting out the potential impacts of climate change on their specific industry.[13]

2.13 This section of the report discusses some of the common biophysical impacts that were raised in submissions and evidence:

- competition for water resources and reduced water availability;
- increases in temperature;
- increasing frequency of extreme climatic events;
- elevated levels of carbon dioxide in the atmosphere; and
- pest and disease distribution and pathogenicity, and weed distribution and management.

2.14 Although issues are discussed individually, it is important to recognise that there is extensive interplay between impacts.

Water resources

2.15 One of the well-recognised implications of climate change on the agricultural industry, particularly in southern Australia, is reduced water availability in a hotter, drier climate.[14] This was highlighted in the Intergovernmental Panel on Climate Change Fourth Assessment Report:

> As a result of reduced precipitation and increased evaporation, water security problems are projected to intensify by 2030 in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions...[15]

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11 *Submission 32*, pp 7-11.

12 Victorian Department of Primary Industries, *Submission 27*, p. 5; Queensland Government, *Submission* 30, pp 8-12.

13 See for example: Apple and Pear Australia Limited (APAL), *Submission 23*, pp 3-6; Growcom, *Submission 31*, pp 9-10.

14 See for example: NFF, *Submission 24*, p. 4; Agricultural Alliance on Climate Change, *Submission 37*, p. 8.

15 Hennessy, K., B. Fitzharris, B.C. Bates, N. Harvey, S.M. Howden, L. Hughes, J. Salinger and R. Warrick, 2007: *Australia and New Zealand. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p. 509.

2.16 As the CSIRO noted in its submission, there are multiple factors which interact to threaten water resources: significant development of surface and groundwater resources; declining rainfall in recent decades; and projected reductions in future rainfall and runoff.[16]

2.17 The New South Wales Irrigators' Council submission clearly sets out the implication of reduced water availability - competition for water resources amongst all users:

> We have recognised that there are multiple users of water – human needs, stock needs, the environment and irrigated agriculture.
>
> We have recognised that those users must share the available water resources – and that some needs are more critical than others.
>
> We have recognised that water must be distributed based on sustainable yields over the longer term.[17]

Implications of reduced water availability

2.18 Reduced water availability affects all areas of the agricultural sector, and many submissions emphasised this point. The NSW Irrigators' Council noted:

> Irrigation sits at the very forefront of climate change policy. The availability and reliability of water is clearly at the heart of irrigation. It is also at the heart of climate change.[18]

2.19 The Western Australian Department of Water highlighted the importance of reliable on-farm water supplies in the dryland agricultural areas of Western Australia:

> … seasonal fluctuations in rainfall necessitate the design of reliable on-farm water supplies so that farming enterprises can continue to function in years with low rainfall. When failure occurs, carting water generates high costs to the farmer in terms of both dollars and time.[19]

2.20 Apple and Pear Australia Limited (APAL) outlined the value of water for its industry:

> In a hotter, potentially drier climate, evaporation and transpiration will be increased leading to increased demands for irrigation and increased water use per hectare. Water has become a valuable resource and is often not available when required. This increased requirement for water, if water is expensive or not available, would lead to reduced orchard viability.[20]

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16 *Submission 32*, p. 11. See also: Victorian Department of Primary Industries, *Submission 27*, p. 7.

17 *Submission 18*, p. 3. See also: Gwydir Valley Irrigators Association, *Submission 14*, p. 3.

18 *Submission 18*, p. 2.

19 *Submission 26*, p. 2.

20 *Submission 23*, p. 4.

2.21 The CSIRO in its coverage of the impacts of climate change on the Australian agriculture sector, highlighted a number of industries as vulnerable to reduced rainfall and water availability. For the sugarcane industry the projected change in the amount, frequency and intensity of future rainfall will be '[p]robably the greatest impact (and adaptation challenge)':

> In many regions the amount of effective rainfall available to the crop will be reduced, whilst water demand is likely to increase due to greater rates of evapotranspiration linked to atmospheric warming.[21]

2.22 In relation to viticulture, the CSIRO said the 'water demand of winegrape vines will increase in a warmer climate while rainfall and, more importantly, runoff to water storages is projected to decrease'.[22] The CSIRO also highlighted the vulnerability of cropping in current 'dry margins', but did note that there may be an expansion into areas that are currently too wet for regular cropping.[23] The CSIRO also indicated that the irrigated dairy industry would be impacted by reduced water availability and concluded that there should be an assessment of the vulnerability of irrigated dairy to reduced water supply.[24]

The relationship between rainfall and run-off

2.23 The committee's Interim Report highlighted the disparity in rainfall projections by different climate models and the difficulty this creates in making definitive statements about changes in precipitation.[25] Dr Mark Howden of the CSIRO noted that for southern Australia there is 'a fair bit of congruence in terms of predictions of lower rainfall', however there still remains uncertainty as to whether there will be a large or small amount of reduction.[26]

2.24 In addition to the uncertainty of predicting changes in rainfall is the further complexity in determining how reduced rainfall will impact on run-off. eWater Cooperative Research Centre (eWater CRC) explained the nature of the relationship in its submission:

> A decrease in catchment precipitation of 10% may lead to a decrease in catchment runoff in the order of 20% to 30%, due to complicated non-linear relationships between the factors.[27]

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21 *Submission 32*, p. 13.

22 *Submission 32*, p. 14.

23 *Submission 32*, p. 8.

24 *Submission 32*, pp 8, 9, 10, and 24.

25 Interim Report, p. 8.

26 *Committee Hansard*, 30 June 2008, p. 15.

27 *Submission 8*, p. 4.

2.25 Dr Michael Coughlan of the Bureau of Meteorology explained to the committee the difficulties in accurately measuring reductions in run-off:

> …measuring rainfall is a lot simpler than measuring run-off. In measuring rainfall we put a bucket out there and measure how much rain falls into it. What happens to the rain after it falls is a pretty complex process. You cannot – or it is difficult – to measure it directly, except what then ultimately ends up in the rivers. So that generally has to be done through some modelling process and if that modelling process is 'uncertain'…often what we ultimately observe will differ from what we actually model. Getting the modelling right is a difficult process. It often depends very much on the particular catchment for which you are doing your modelling. So what you might observe as effective run-off in, say, Western Australia might differ quite markedly from, say, in south-eastern Australia.[28]

2.26 Professor Michael Young of the Wentworth Group of Concerned Scientists, acknowledged that there was much more 'sophisticated' science behind such predictions, but provided the committee with a 'rule of thumb' estimation for reduction of run-off resulting from a reduction in rainfall:

> The reality is…that for every one per cent reduction in mean rainfall, inflows into dams dropped by about three per cent. As you get to really dry steps, it becomes more like four per cent and even five per cent. That really matters and it happens because you have to wet a landscape before you get run-off.[29]

2.27 The evidence of a representative of the Murray-Darling Basin Commission, in describing the impact of successive dry seasons on run-off in the Murray-Darling Basin, provided a prime example of the phenomena described by Professor Young:

> What we have at the moment with the current situation is the 10 lowest rainfall years on record, and so average inflows into the Murray system have dropped dramatically. The year 2006-07 was the driest on record. But perhaps more importantly there has never been a period of regularly dry seasons one after the other…
>
> The pattern we have been seeing is that rainfall has been reduced during the autumn. The effect of this is that the catchments do not wet up in the same way as they did previously and so there is a much greater decline in run-off than in rainfall.[30]

2.28 The committee also questioned representatives of the Murray-Darling Basin Commission on how reduced inflows into the Murray-Darling Basin would impact on the water available for irrigation and the environment:

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28 *Committee Hansard*, 30 June 2008, p. 23.

29 *Committee Hansard*, 1 July 2008, p. 40.

30 Mr Jason Alexandra, Director, Water Policy Coordination, Murray-Darling Basin Commission, *Committee Hansard*, 30 June 2008, p. 67.

> There was work done by the Victorian Department of Sustainability and Environment as part of the northern region water strategy…that looks at the reduction of inflows under a range of scenarios and then how that would play out in terms of reductions to irrigation and to environmental flows…For example, for the Murray, under the medium impact of climate change scenario, they have modelled a 25 per cent reduction in inflows, a six per cent reduction to irrigation and a 33 per cent reduction to the environment. So that is assuming that, if you like, the rules are not changed and you will get that disproportionate impact for the environmental water.[31]

2.29 The representative for the Murray-Darling Basin Commission agreed that such a disproportionate impact would not be sustainable.[32]

Sustainable Water Policies

2.30 The Gwydir Valley Irrigators Association stated in its submission that one of the challenges of government is to decide how to share what may be decreased, or increased, levels of water availability.[33]

2.31 The committee received submissions giving examples of water policies which enabled sustainable water distribution to agriculture. The Western Australian Department of Water noted that 'a well planned, well organised and integrated' approach to water supply development was required in the dryland areas of the agricultural regions of Western Australia:

> The Rural Water Plan was developed as a strategic tool to encourage rural farming communities to be involved in water supply projects; accept an element of responsibility; take ownership of local water supply assets; and engage in an ongoing planning and improvement process. By employing an integrated planning approach, it is possible to develop reliable on-farm water supplies that meet all domestic, crop spraying and livestock needs in most agricultural areas. An ad hoc approach to water supply development can result in inadequate or ineffective supplies that fail during extended dry periods which are predicted to be the norm in the future.[34]

2.32 Both the NSW Irrigators' Council and the Gwydir Valley Irrigators Association made submissions to the effect that the current water sharing plans in NSW are robust enough to deal with climate variability and climate change. In its submission the NSW Irrigators' Council described how, in NSW, Water Sharing Plans (WSPs) have been documented and agreed which recognise the multiple demands on water resources:

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31 Mr Jason Alexandra, *Committee Hansard*, 30 June 2008, p. 70.

32 Mr Jason Alexandra, *Committee Hansard*, 30 June 2008, p. 70.

33 *Submission 14*, p. 2.

34 *Submission 26*, p. 2.

> An Available Water Determination (AWD) pursuant to the WSP is made on a regular basis stating the total amount of water that can be used in a delineated time period by all users. In the event that climate variability or change result in less water being available, the AWD method set out in the WSP will distribute that water which is available in a pre-determined method.[35]

2.33 However, the Murray-Darling Basin Commission noted in their evidence that current systems for water distribution only cover part of the extraction cycle:

> What we are really seeing is – under scarcity of water – that there is increasing demand. There are a whole lot of ways of accessing that available water resource, and the systems we have for allocating water have only developed to deal with part of the extraction cycle.[36]

Higher temperatures

2.34 Higher temperatures are projected to have significant impacts on the Australian agriculture sector. Dr Mark Howden of the CSIRO noted in his evidence to the committee that there is a 'strong degree of congruence in the forecasts about increases in temperature' and these can be slated back to regional implications.[37]

2.35 The CSIRO's submission stated that there is an increased likelihood that heat stress on livestock and crops is likely to occur in certain areas of Australia, for example the 'Mediterranean' south-west of Western Australia, the south-east of South Australia, and the south-west of Victoria; and the 'subtropical moist' areas of the south-east coast.[38] The Queensland Government also stated in its submission that heat stress would constrain beef production and that heat shock will decrease the dough making qualities of grain.[39]

2.36 The CSIRO noted the intensive livestock industry in south-west Tasmania may benefit from 'warming and drying' and there may be reduced energy demands for heating production sheds.[40]

2.37 Growcom provided the committee with details of a grower workshop on horticulture and climate change it hosted in January 2008. Participants at the workshop indicated that increased temperatures were an important issue for consideration in the horticultural industry:

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35 NSW Irrigators' Council, *Submission 18*, p. 3.

36 Mr Jason Alexandra, *Committee Hansard*, 30 June 2008, p. 70.

37 *Committee Hansard*, 30 June 2008, p. 15. See also: Interim Report, p. 7; Agricultural Alliance on Climate Change, *Submission 37*, p. 7.

38 *Submission 32*, p. 8.

39 *Submission 30*, pp 1 and 9.

40 *Submission 32*, p. 7.

> increased temperature is likely to present a more critical issue than reduced rainfall due to the sensitivity of crops to temperature change and the intensive / irrigated nature of horticulture production.[41]

2.38 APAL outlined in its submission that increasing temperatures will be an important factor for the pome fruit industry:

> The most obvious impact for pome fruit such as apples and pears will be the expected continued rise in temperatures and hence a reduction in chilling hours.
>
> …Another impact of warming, particularly rising minimum temperatures, is expected to be a decreased incidence of frost. As apples require frost-free conditions once the buds begin to open there may be some benefits in this. However, the situation is likely to be more complex. For example, if rising minimums are accompanied by greater variability there may be an increased risk of unexpected frost at critical times.[42]

2.39 Evidence to the committee also demonstrated the important interplay between higher temperatures and reduced water availability:

> …just a one per cent increase in average temperature is deemed to have a significant impact, because it means that the longer, warmer period of active plant growth – those forested catchments – will use more water and, therefore, less will go as run-off.[43]

2.40 Increasing temperatures are also expected to have impacts on pest and disease distributions across Australia, and this is discussed below in the section 'Pests, disease and weeds'.

Extreme climatic events

2.41 The committee's Interim Report briefly discussed *Climate Change in Australia's* projections in relation to extreme climatic events such as droughts, bushfires and storms. *Climate Change in Australia* projected that there would be:

- increases in agricultural droughts (periods of extremely low soil moisture);
- a substantial increase in fire weather risk in south-eastern Australia; and
- the potential for significant increases in inundations from storm surges, resulting in flooding and erosion, due to higher mean sea level and more intense weather systems.[44]

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41 Growcom, *Submission 31*, attachment: Growcom, *Growcom horticulture and climate change workshop report*, 25 January 2008, p. 4.

42 *Submission 23*, p. 3.

43 Mr Jason Alexandra, *Committee Hansard*, 30 June 2008, p. 78.

44 *Climate Change in Australia Summary Brochure – Observed changes and projections*, pp 11-12. See also: Interim Report, p. 9.

2.42 The Intergovernmental Panel on Climate Change also highlighted the effect of drought and fire on agricultural and forestry production in Australia:

> By 2030, production from agriculture and forestry is projected to decline over much of southern and eastern Australia, and over parts of eastern New Zealand, due to increased drought and fire.[45]

2.43 The committee received some submissions and evidence on the impact that these extreme climatic events would have on the Australian agricultural sector. The Victorian Department of Primary Industries stated in its submission that these increases in extreme climatic events were a greater threat to agriculture and forestry than anticipated changes in temperature:

> Increased climate variability, which implies an increased frequency and intensity of extreme climatic events, is likely to pose a greater threat to many agriculture and forestry businesses than anticipated changes in average temperatures. This is due to its combination of greater unpredictability coupled with increased intensity of natural disasters e.g. fire, flood, drought and disease. An important issue for farmers is their capacity to recover from extreme climate-related events such as droughts, floods and fires.[46]

2.44 Similarly, the BoM stated that the impact of climate change on agriculture will result in the interaction of climate variability and long-term trends, leading in particular to more frequent extreme events:

> Such outcomes might be characterised by events such as the recent droughts, which have seen record high temperatures compounding the rainfall deficiencies.
>
> This interaction means that climate change is likely to occur as a series of shocks during which systems experience new combinations of stressors.[47]

2.45 The evidence to the committee on the impacts of drought demonstrated that the impacts went beyond reduced precipitation and water availability. Ms Nicolette Boele of the Agricultural Alliance on Climate Change (AACC) described the ongoing pressure of droughts as a 'cancer', which will only be exacerbated by climate change.[48] The Queensland Government's submission noted that more frequent and severe drought events would mean that the state's stock route network, which is used for moving stock and short term drought relief, would become increasingly important to the pastoral industry.[49] The CSIRO also noted that the cost of horticultural crops tend

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45 IPCC, 2007: *Climate Change 2007: Synthesis Report. Contributions of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, p. 50.

46 *Submission 27*, p. 12 (references not included). See also: Growcom, *Submission 31*, p. 7.

47 *Submission 7*, p. 4.

48 *Committee Hansard*, 1 July 2008, p. 22.

49 *Submission 30*, p. 9.

to rise during droughts, and that this would be expected to occur more often if there was an increased frequency of droughts.[50]

2.46 A number of submissions highlighted the potential risks faced by the forestry industry from a projected increase in frequency and severity of bushfires.[51]

Rising carbon dioxide (CO_2) levels

2.47 Another of the biophysical changes that may have an effect on agricultural production is the increasing concentration of carbon dioxide in the atmosphere. As the eWater CRC explained in its submission:

> The effect of rising atmospheric CO_2 concentrations on vegetation growth in agricultural zones, generally, is to increase vegetation productivity for a given amount of available water (i.e. precipitation). This 'CO_2-fertilisation' effect will go some way to counteracting decreases in productivity if precipitation decreases over time.[52]

2.48 The eWater CRC submission goes on to state that there is some evidence already that there have been increases in vegetation cover over the past 2-3 decades, even in places where precipitation has declined. However, the eWater CRC cautions:

> There are no simple, generic rules about how vegetation will change. There is some evidence indicating that enhanced CO_2 concentration will increase the productivity of long-lived, deep-rooted species (e.g., perennial vegetation) more than short-lived species (e.g., annual grasses and crops).[53]

2.49 According to the eWater CRC, the implications of this are that tree-based cropping systems may become relatively more productive than those systems are currently.[54] On this point, the CSIRO note that grazing in some regions of Australia may be impacted by rising carbon dioxide levels favouring trees over pasture production, and that pasture quality may decline.[55]

2.50 The Queensland Government submission also noted that a rise in carbon dioxide concentration in the atmosphere may increase pasture growth, particularly in water-limited environments. However, the Queensland Government referred to studies

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50 *Submission 32*, p. 15.

51 See for example: National Association of Forestry Industries, *Submission 6*, p. 2; Victorian Department of Primary Industries, *Submission 27*, p. 5; and CSIRO, *Submission 32*, p. 15.

52 *Submission 8*, p. 4. See also: CSIRO, *Submission 32*, p. 9, in relation to impacts of grazing in the subtropical sub-humid areas of Australia where the impacts of reduced rainfall and increasing incidence of drought on savannas may be offset by increased CO_2 levels and prolonged growing season from warming.

53 *Submission 8*, p. 5.

54 *Submission 8*, p. 5.

55 *Submission 32*, pp 9-10, in relation to grazing in the subtropical sub-humid, tropical warm-season moist, and tropical warm-season wet areas of Australia.

which indicated that this increase in plant productivity may be offset by a 10% reduction in rainfall:

> A rise in CO_2 concentration is likely to increase pasture growth, particularly in the water-limited environments in Australia and specifically Queensland. However, if rainfall is reduced by 10%, this CO_2 benefit is likely to be offset. A 20% reduction in rainfall is likely to reduce pasture productivity by an average of 15% and live weight gain in cattle by 12%, substantially increasing variability in stocking rates and reducing farm income.[56]

2.51 The Queensland Government submission also outlined the impact of increased levels of carbon dioxide in the atmosphere on the nitrogen content of plants:

> Elevated concentrations of CO_2 significantly decrease leaf nitrogen content and increase non-structural carbohydrate, but cause little changes in digestibility. In farming systems with high nitrogen forage (e.g., temperate pastures), these effects are likely to increase energy availability, nitrogen processing in the rumen and productivity. In contrast, where nitrogen is deficient (e.g., Queensland's extensive rangelands), higher temperatures are likely to exacerbate existing problems by decreasing non-structural carbohydrate concentrations and digestibility, particularly in tropical C4 grasses.[57]

2.52 eWater CRC also noted that with increasing levels of carbon dioxide, and the possibility of increased productivity to some types of vegetation, woody weed control may become increasingly important.[58] The CRC for National Plant Biosecurity stated that elevated carbon dioxide levels in the atmosphere may also affect plant pest pathogens.[59] The issue of weed management and pests is discussed further in the section 'Pests, disease and weeds'.

Pests, disease and weeds

2.53 A number of submissions highlighted the impact changing climate could have on the distribution and pathogenicity of pests and diseases, and weed distribution and management. These impacts are generally secondary impacts, resulting from changes in temperature, rainfall or atmospheric carbon levels.[60]

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56 *Submission 30*, p. 9 (references not included). See also: Victorian Department of Primary Industries, *Submission 27*, p. 7.

57 *Submission 30*, p. 9 (references not included).

58 *Submission 8*, p. 5.

59 *Submission 16*, p. 2.

60 See for example Council of Australasian Weed Societies Inc, *Submission 5*; Cooperative Research Centre for National Plant Biosecurity (CRC for National Plant Biosecurity), *Submission 16*; CRC for Australian Weed Management, *Submission 19*; Queensland Government, *Submission 30*, pp 6-7.

Distribution and pathogenicity of pests and diseases

2.54 The CRC for National Plant Biosecurity stated in its submission that changes are already occurring in the distribution of pests and pathogens:

> A poleward shift in the geographical range of some pests and pathogens has been observed during the last century … Rising temperatures associated with climate change are predicted to be associated with the future poleward movement of other Emergency Plant Pests (EPPs) …[61]

2.55 The CRC for National Plant Biosecurity used the example of citrus canker to demonstrate how these changes could impact the Australian agricultural sector:

> A recent modelling analysis indicated that if citrus canker had become established in Queensland, the geographical range of the pathogen, *Xanthomonas axonopodis* pv.*citri*, was predicted to extend further south to major Australian citrus growing regions with a 1-5ºC temperature increase …[62]

2.56 APAL indicated that increased pesticide applications, one of the potential flow on effects of changed plant pest distributions, could impact on the export market for orchard fruits:

> Warmer conditions will have significant effects on the orchard ecosystem including many orchard pests and potentially their predators. There will be movement of warm climate pests, notably fruit flies, from warmer production areas to areas that are currently free of these pests. This would necessitate additional pesticide applications targeting this pest and potentially affects market access for fruit to export countries such as Japan.
>
> For other pests such as codling moth and light brown apple moth, it is anticipated there would be an increase in the number of breeding cycles per year … As the number of insects in an orchard increases with each breeding cycle an extra cycle will lead to a substantial increase in insect pressure. This has a compounding effect in that the extra cycle also leads to an increase in the number of insects that over winter and hence to an increase in the number of insects present in the first breeding cycle in the following spring. As many of the chemicals used to control these pests are banned in export countries, as are the presence of live insects in consignments, this would have a negative impact on the export of fruit out of Australia.[63]

2.57 APAL also stated that warmer weather would also increase the incidence of plant diseases:

> …plant diseases grow, multiply and infect at faster rates in warmer weather. Hence with global warming there would be an increase in the incidence, severity and spread of orchard diseases that will need to be

61 *Submission 16*, p. 1 (references not included).

62 *Submission 16*, pp 1-2 (references not included).

63 *Submission 23*, p. 6.

> controlled. This would have a very negative impact on the growing organic industry, which lacks good disease control chemicals. In addition, as for insecticides, many of the chemicals used to control these diseases are banned in export countries, as are the presence of the diseases in consignments.[64]

2.58 The Queensland Government, while highlighting the many ways climate change could impact on the distribution of pests, also noted that there may be some benefits of climate change in terms of controlling some pests:

> Climate change will reduce the impacts and/or range of some pest species and there is likely to be increased opportunities to better manage some species due to less favourable climatic conditions (e.g. reduced rainfall, drought).[65]

2.59 While predictions can be made about the changing distribution of plant pests, the CRC for National Plant Biosecurity expressed the concern that other impacts of plant pests required further investigation:

> While future spatial distribution can be predicted under climate change scenarios using models and examining historical trends, there appears to be limited knowledge of how climate change will impact on the biology of the EPPs (e.g. pathogenicity) and how the interaction with their host responds to potentially many climatic factors. Major climate change factors identified that affect plant pest infestation and diseases include increased atmospheric CO_2, frost, heavy and unseasonal rains, increased humidity, drought, cyclones and hurricanes, and warmer temperatures.[66]

2.60 Of particular concern is the impact of increased levels of carbon dioxide in the atmosphere which, according to the CRC for National Plant Biosecurity, may modify pathogen aggressiveness and/or host susceptibility and affect the initial establishment of the pathogen.[67]

2.61 The Queensland Government submission also addressed the impact of climate change on the distribution and pathogenicity of animal diseases:

> The world is facing an unprecedented impact from emerging and re-emerging animal diseases that have a major impact on production and trade (e.g. nipah virus, foot and mouth disease, tuberculosis). Climate change can affect many processes that influence animal diseases including the pathogen or parasite, the host, the vector and the behaviour of the disease (epidemiology). Warmer temperatures and more extreme rainfall events will produce conditions that are more favourable to many livestock

64 *Submission 23*, p. 6. See also: Growcom, *Submission 31*, p. 9.

65 *Submission 30*, p. 6.

66 *Submission 16*, p. 2.

67 *Submission 16*, p. 2.

> diseases. Insect vectors of disease such as mosquitoes and midges are likely to expand their range increasing the risk of disease spread to new areas.[68]

Weed distribution and management

2.62 The committee received a limited number of submissions that highlighted the importance of weed distribution and management as one the impacts arising from climate change.

2.63 In its submission, the CRC for Australian Weed Management summarised the potential that climate change presented for weed invasion:

> Overall, climatic changes place existing vegetation, whether native, pasture or crops, under stress. This creates spaces for new species to move into, and species with efficient dispersal mechanisms, whether by bird, wind, water or by human activities, are the best equipped to take advantage of the spaces created. Invasive plants generally have excellent seed transport mechanisms, often by human activity or by birds, and are likely to spread rapidly into new areas, quickly exploiting changing climatic conditions that favour their establishment. Climate change can therefore be expected to favour invasive plants over established vegetation including crops, especially if accompanied by an increase in extreme conditions such as droughts alternating with very wet years.[69]

2.64 The CRC for Australian Weed Management outlined in its submission how specific changes in climate may impact weed distribution, for example: as a result of higher temperatures all invasive plants can be expected to shift southward in range, with tropical and subtropical species moving south, and temperate species being displaced southward; many weeds have a carbon metabolism which will benefit greatly from increased atmospheric carbon dioxide; reduced rainfall may limit or reduce the distribution of weeks in some localities. However, the CRC for Australian Weed Management stated that there was a 'real need for an independent scientific review of currently-available modelling tools used to predict how plants, in particular current and potential weedy species, will respond to changing climate scenarios'.[70]

2.65 In evidence to the committee, Associate Professor Christopher Preston of the CRC for Australian Weed Management stated that, in his opinion, the biggest issue for weed distribution in the context of climate change is the reduced availability of water:

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68 *Submission 30*, p. 7.

69 *Submission 19*, p. 1. See also: the Department of Agriculture, Fisheries and Forestry and Department of Climate Change, *Submission 34*, p. 3.

70 *Submission 19*, pp 1-2. See also: eWater CRC, *Submission 8*, p. 5, on the impacts of elevated atmospheric carbon dioxide levels and the potential implications for woody weed management; CSIRO, *Submission 32*, p. 9, which states that pest and disease impacts on the horticultural industry in temperate cool-season wet regions may be reduced with lower rainfall projected.

> One of the issues that arise is the inability to have good pasture coverage because of lower rainfall patterns at various times, and that allows weed invasion into pastures. The second one that is quite important in the grains industry has been the change in rainfall pattern from one almost entirely dominated by winter rainfall to having increasing amounts of summer rainfall. Farmers are needing to spend more time, effort and money controlling summer weeds because they need that moisture to grow a crop. Severe weather conditions can also be a major issue because they create gaps in the environment for weeds to invade.[71]

2.66 Associate Professor Preston also identified the abandoning of farms, arising from reduced water availability, as another potential means of weed invasion:

> The majority of farmers in Australia have most of their equity in land and their land is only as valuable as the water that they can get. So with declining water resources, whether that is declining irrigation or declining rainfall, there is the chance that for many of these farmers their land will become less and less valuable. That makes it more and more difficult for them to move out of the industry or move into different industries and it creates the issue where, instead of changing industries, the land is just abandoned and allowed to go to waste. Again, that is an opportunity for weed invasion.[72]

2.67 The CRC for Australian Weed Management also indicated that there is a need to modify existing weed risk assessment systems to take into account possible 'sleeper' weeds that may be favoured by a changing climate.[73]

2.68 In evidence to the committee, Associate Professor Preston raised a further issue in relation to weed management, specifically the introduction of species for biofuel production:

> The Australian environment is littered with examples of industries which seemed like a good idea at the time but which, for one reason or another, never really made it. In many of those situations we have plant species that have become weeds and animal species that have become feral. Rubber vine is probably a good example of this; olives are another example that I am very familiar with, coming from South Australia – these sorts of boom and bust industries. I think we need to be very careful about how we go forward with the biofuels sector. Many of the species that have been touted as prominent biofuels species, like jatropha, are well known worldwide for

71 *Committee Hansard*, 30 June 2008, pp 93-94.

72 *Committee Hansard*, 30 June 2008, p. 94.

73 *Submission 19*, p. 1. See also: Associate Professor Preston, *Committee Hansard*, 30 June 2008, p. 93; and Queensland Government, *Submission 30*, p. 6. Weed risk assessment systems are used by the Australian Quarantine and Inspection Service and others for border protection but also widely used by states and regions for post-border weed prioritisation.

> being weedy, and if the industries do not take off we could well be left with a legacy of weeds on our hands.[74]

2.69 The committee followed up the issue of the management of new species with Mr Kevin Goss of the Future Farm Industries CRC:

> We have a weeds protocol that the [Future Farm Industries] CRC has adopted and that we implement. The weeds protocol has being worked out in a joint project with the CRC for Australian Weed Management … We apply that to all that we do. That, importantly, is not simply about bringing plants into the country, which is a matter for Biosecurity Australia and [the Australian Quarantine and Inspection Service]; that protocol extends to how we manage the sites internally and to our ongoing observation of those sites and dealing with any issues that arise.[75]

2.70 The committee also received a submission from the Council of Australasian Weed Societies Inc which stated that 'weeds are widely recognised as one of Australia's most pressing natural resource management issues' and that farmers have recently ranked weeds as their greatest national resource management issue. The Council of Australian Weed Societies submission also noted the social costs that weed management impose on farmers:

> These include health risks through toxins in livestock products and allergenic pollens, loss of access and amenity in national parks and waterways, and increased fire risks in peri-urban areas from dense thickets of invasive grasses and shrubs. The major social impact of weeds is the time-demanding nature of weed control – a loss of productive and recreational time borne by many Australians.[76]

Non-climatic impacts of climate change

2.71 The range of impacts of climate change on the Australian agricultural sector is not limited to climatic impacts. The next section of the report discusses the potential flow-on effects from climate change on three areas to demonstrate the breadth of climate change implications on the Australian agricultural sector, specifically:

- rural communities;
- biodiversity in the Australian landscape; and
- consumer expectations.

Rural communities

2.72 The impacts of climate change on the Australian agricultural sector will have immediate consequences for rural communities. The Agricultural Alliance on Climate

74 *Committee Hansard*, 30 June 2008, p. 94.

75 *Committee Hansard*, 30 June 2008, p. 90.

76 *Submission 5*, p. 1.

Change (AACC) painted a bleak picture in its submission of the impact of climate change on rural communities, particularly where farmers are struggling to adapt to changing their farming practices to new climatic conditions:

> …as is happening still in some areas of Australia gripped in drought, some farming families and communities will experience financial hardship and chronic social pressures, especially mental health issues.
>
> The recently established NSW Rural Mental Health Network identified climatic change impacts, such as drought, as a key external driver of mental health problems in rural Australia…the NSW Farmers' Association highlighted that deaths from suicide of male farmers and farm workers are now double that of any other group in the male population.[77]

2.73 The AACC submission went on:

> If adapting to climate change proves too difficult in some areas, populations will decline and the abandonment of rural towns and farming areas could follow, with the consequent loss of local history, culture and dire natural resource implications. The advent of weeds, pests, disease and erosion could be considerable resulting from the exodus from certain rural and remote areas.[78]

2.74 The Australian Landcare Council submitted that the social impacts of climate change for these communities is largely being ignored:

> Should climatic variability increase significantly, the social impacts may be considerable, especially among rural communities, although it should be said that not all social impacts will be negative. Studies by rural social scientists of this topic should be encouraged and supported.[79]

2.75 The committee's inquiries on this issue found that there is little evidence of work being done on the impacts of climate change on rural communities. Mr Andrew Dolling of the Victorian Department of Primary Industries indicated to the committee that the department is 'cognisant' of the social impacts of climate change:

> …we do take into consideration the social impacts of the various climate change and policy scenarios. We do have an area which is specifically undertaking social research related to a number of challenges that farming communities face, of which climate change is one. There are, of course, others.[80]

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77 Agricultural Alliance on Climate Change, *Submission 37*, p. 10.

78 Agricultural Alliance on Climate Change, *Submission 37*, p. 10.

79 *Submission 13*, p. 5.

80 *Committee Hansard*, 1 July 2008, p. 70.

2.76 Ms Boele of the AACC informed the committee that the AACC has not done much work investigating the flow-on effects of climate change on rural communities, however, the AACC is 'very committed' to better understanding those impacts.[81]

Biodiversity in the Australian landscape

2.77 The submission from Hawkesbury Harvest explained the important role that the agricultural sector has in maintaining biodiversity in the Australian landscape:

> Agriculture has an important role in providing for biodiversity at a landscape scale. Agricultural landscapes are where soils are produced, nutrients recycled, water infiltrates through crops/grasslands. These landscapes are also useful for maintaining remnant vegetation that can act as fauna links through vegetative corridors and buffer the edge of urban development from natural areas.[82]

2.78 Representatives of the forestry industry also gave evidence to the committee about the important role that sector plays in maintaining biodiversity.[83]

2.79 Given the important role that agriculture has in this area, the committee was interested to hear about the impacts that climate change would have on biodiversity. The committee was told by a number of organisations how they assessed the biodiversity impacts of climate change and adaptative options.

2.80 In evidence to the committee Dr Mark Howden of the CSIRO noted that 'one of the three delivery themes that the Climate Adaptation Flagship focuses on is biodiversity and ecosystem services'. Further, Dr Howden stated that 'clearly' this issue is in the CSIRO's sights in its work on investigating adaptation by the agriculture sector.[84]

2.81 Mr Goss of the Future Farm Industries CRC also gave evidence about how that organisation's research aims to look at the impacts of biodiversity:

> …we are selecting among native plants for potential productive plants on farms. Some of these are known but some are very new. We have people who have been out plant collecting and looking afresh at a whole suite of Australian native plants and then putting them through an assessment. We have got this down to, let's say, tens of plants that we think are worth a

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81 *Committee Hansard*, 1 July 2008, p. 22.

82 *Submission 12*, attachment: Ian Knowd, David Mason, Andrew Docking, *Urban agriculture: The new frontier*, Changing City Structures, 2006, p. 23-12 (references not included).

83 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Committee Hansard*, 30 June 2008, p. 101.

84 *Committee Hansard*, 30 June 2008, p. 3; See also: Dr Michael Robinson, Executive Director of Land & Water Australia, and Chair of the Joint Strategy Team for the National Climate Change Research Strategy for Primary Industries (CCRSPI), *Committee Hansard*, 30 June 2008, p. 64. The National Climate Change Research Strategy for Primary Industries is discussed in detail in Chapter 5.

> closer look, and some of them are planted out already. Some are leguminous; some are not. They are all perennial and they are selected because they are very well adapted to what we see as the climate they are going to face in the future. You could conclude that that is a good thing from a biodiversity viewpoint, but—and I think this is behind your question—our job is not to assume that. Our job is, when it is in these potential productive systems, to actually observe that and then build some capacity to predict what the biodiversity benefits might be.[85]

2.82 The Sydney Centre for International Law outlined international obligations that the Australian Government has under the *Convention on Biological Diversity* (1992), as implemented in the *Environment Protection and Biodiversity Protection Act* 1999 (Cth). The Sydney Centre for International Law noted that such obligations may, in some cases, require Australia to abandon farming in areas where serious harm to biodiversity results:

> In such cases, it may be appropriate to return some areas currently used for pasture to protected areas such as national parks. There may be economic opportunities arising from increased tourism in new national park areas. Of course it should be noted that protected areas themselves will be subject to climate change pressures which will require responses.[86]

2.83 The committee heard evidence from Dr Christine Jones giving a very positive example of how changes to farm management practices were improving the biodiversity of some agricultural lands.

> Birds have also started to come back onto their farms. People have got thousands of little grass-feeding birds like cisticolas – which, honestly, I had never heard of – on their farms. Apparently they were very common at one time. And now that we are providing this habitat, little ground-foraging native animals like bettongs, which are like little rat kangaroos and live in grasslands, are coming back onto farms that at one time were sprayed from one end to the other and had no ground cover. So we are getting this whole biodiversity thing.[87]

Consumer expectations

2.84 The committee also received evidence on how climate change would impact on consumer expectations. For example, the Food Industry Council of Tasmania (FICT) highlighted the impact that climate change would have on the agricultural sector from a marketing perspective because consumers are becoming more discerning in their purchasing habits:

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85 *Committee Hansard*, 30 June 2008, p. 89.

86 *Submission 39*, pp 4-5.

87 *Committee Hansard*, 30 June 2008, pp 53-54.

> Food miles and carbon footprinting are two areas of focus for FICT due to Tasmania's relatively high value of agricultural products and our distance from consumer markets…
>
> In some cases, these factors are already affecting Tasmanian food and beverage products' access to markets both nationally and internationally.[88]

2.85 The FICT also noted a growing international movement to introduce 'carbon' labels, showing greenhouse gas emissions created in the production, transportation and eventual disposal of all products. The FICT noted that these carbon labels would allow consumers to make choices about their consumption based on the carbon footprint of the product.[89]

2.86 Mr Charles McElhone of the National Farmers Federation provided to the committee an example of one study demonstrating how food miles may be misrepresentative of the real impact of food production on the environment:

> …there are some studies out of Lincoln University in New Zealand which demonstrate that food from production systems in New Zealand shipped to Europe has a lower carbon footprint than the same food produced in a UK heated greenhouse and delivered to those same consumers. So to just look at the transportation element within the carbon footprint is very misleading.[90]

2.87 Mr McElhone went on to state that food miles may in fact be an opportunity for Australian agriculture:

> We are saying that it is widely acknowledged that Australian agriculture production systems are low intensity in terms of their emissions per unit of production output and therefore there may be an opportunity from a global marketplace perspective if we get the science right in understanding the life cycle of agriculture emissions in our production systems more effectively.[91]

2.88 Dr Michael Robinson of Land & Water Australia indicated that food miles is definitely an area requiring further research:

> We have received a very clear, very strong message that we need to do full life cycle analysis on agricultural products so that we do not get inappropriate, I guess, or the wrong answers out, and so that we do not get perverse outcomes.[92]

2.89 Meat and Livestock Australia also highlighted the impacts of changing consumer demands in the light of climate change:

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88 *Submission 25*, p. 1.

89 *Submission 25*, p. 1.

90 *Committee Hansard*, 1 July 2008, p. 29.

91 *Committee Hansard*, 1 July 2008, pp 29-30.

92 *Committee Hansard*, 30 June 2008, p. 63.

> …The increased media focus on greenhouse implications of products, including food is creating an expectation of environmental 'ethics' that is subject to manipulation by advocates of particular views, e.g. the anti-meat lobby. A shift away from meat-based diets towards vegetable-based diets will have important ramifications for the economic viability of livestock producers and processing industries. It will also have impacts on landscape health if more fragile lands are cropped rather than grazed, especially under irrigation.[93]

93 *Submission 36*, p. 5.

Chapter 3

Challenges and opportunities for current and future farm enterprises

Introduction

3.1 Submissions and evidence to the Inquiry emphasised the innovative nature of Australian farmers in working with a variable climate:

> The Australian agricultural sector is one of the most efficient and well-managed in the world. Australian farmers, given the volatility of climatic conditions and the landscape have become highly experienced at land and water management practices. They continue to innovate in terms of land management practices, with due consideration of their operations towards sustainable and environment best practice.[1]

3.2 This chapter discusses the opportunities and challenges that climate change presents to the Australian agricultural sector. The chapter starts with a discussion of adaptation by Australian agricultural enterprises to climate change. The discussion then turns to opportunities and challenges for the agricultural sector in relation to mitigating and offsetting greenhouse gas emissions. The chapter concludes with a brief consideration of assessing mitigation and adaptation strategies to avoid perverse outcomes.

Adapting to climate change

3.3 During the course of the Inquiry, the committee was told of the prospects of the Australian agricultural sector to adapt to climate change. The submission of the Agricultural Alliance on Climate Change (AACC) noted that 'some production activities will be better able than others to respond; generally speaking it will be the more intensive activities that are more capable of adapting to a changing climate'.[2] The AACC's submission went on to state:

> Policies that support farmers to adapt to and build in resilience to climate change impacts are preferred to those that prescribe certain areas of the landscape unsuitable for agricultural industries.[3]

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1 Westpac Banking Corporation, *Submission 28*, p. 2. See also: National Farmers' Federation (NFF), *Submission 24*, p. 5; Department of Agricultural, Fisheries and Forestry and the Department of Climate Change (DAFF/DCC), *Submission 34*, p. 10; and Mr Tim Wiley, *Committee Hansard*, 30 June 2008, p. 39.

2 *Submission 37*, p. 8, quoting from J. Sherrard, A. Tate and N. Boele: *Agricultural Alliance on Climate Change: Issues Paper*, July 2007. Available at: http://www.climateinstitute.org.au/images/stories/agribusinesspaper.pdf, accessed 12 November 2008.

3 *Submission 37*, p. 10.

3.4 In contrast, Mr Ian Bowie noted that the Australian agricultural sector 'has gone so far already in adapting to climates that are normally dry, often hot and subject to extremes of drought, flood, fire and plagues and it is hard to see where further it may go'.[4]

3.5 In its submission, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) highlighted that the uncertainty associated with projecting future climate means that adaptation to climate change will need to take a flexible, risk-based approach that incorporates future uncertainty and provides strategies that will be able to cope with a range of possible local climate changes:

> Initial efforts in preparing adaptation strategies should focus on equipping primary producers with alternative adaptation options suitable for the range of uncertain future climate changes and the capacity to evaluate and implement these as needed, rather than focussing too strongly yet on exactly where and when these impacts and adaptations will occur.
>
> Adaptation measures will have to reflect and enhance current 'best-practices' designed to cope with adverse conditions such as drought. Marginal production areas are amongst the most vulnerable and will likely be amongst the first areas in which the impacts of climate change will exceed adaptive capacity.[5]

3.6 The joint submission of the Department of Agriculture, Fisheries and Forestry (DAFF) and Department of Climate Change (DCC) outlined some of the decision making tools being developed to assist farmers to manage climate risks. For example the *Managing Climate Variability Program* (MCVP) which aims to enhance adaptation responses to a variable climate:

> The program's top priority is to provide more accurate and reliable climate information, forecasts and tools to enable farmers and natural resource managers to reduce their exposure to risk from climate change …
>
> The MCVP has contributed to the development of seasonal climate forecasting tools that assist managers to make decisions which maximise climate opportunities and reduce costs in poor seasons.[6]

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4 *Submission 2*, p. 4.

5 *Submission 32*, p. 4. The CSIRO's submission draws heavily from a report the Commonwealth Scientific and Industrial Research Organisation (CSIRO) prepared for Land & Water Australia: C.J. Stokes and S.M. Howden (eds), *Overview of climate change adaptation in the Australian agricultural sector*, February 2008. Available at: http://www.csiro.au/resources/AgricultureAdaptationReport2008.html#1, accessed 12 November 2008. See also: Bureau of Rural Sciences, *Farming profitably in a changing climate: a risk-management approach*, February 2006, p. 7. Available at: http://affashop.gov.au/product.asp?prodid=13353, accessed 14 November 2008; and Victorian Department of Primary Industries, *Submission 27*, p. 14.

6 *Submission 34*, p. 13. See also: Bureau of Meteorology, *Submission 7*, pp 5-6.

3.7 In its Interim Report the committee noted the need for downscaling of climate projections to a local level to be of greater use to farmers. The committee also noted the need for improved communication of climate projections to farmers and others in the agricultural sector.[7] As the committee heard during the course of the Inquiry, the availability of this type of information is a key factor in assisting farmers to manage the risks of climate change. Mr Hamish Munro, a Councillor of the Cattle Council of Australia described for the committee the importance of being able to access reliable long term projections:

> Some of the climate models that you can readily access on the internet at the moment are quite good for one or two days, but I think we need more research into longer term models because, for websites, anything that is seven to 10 days is merely speculative for them. They are not close to what actually happens within that short time frame. I think we need to be able to progress having these short-term models and work through to longer-term models so that we can actually predict some of these impacts on pastures, animal production and also what ramifications climate change is going to have for consumers as well as producers.[8]

3.8 To this end, the committee was also told about the development of better information systems which would provide farmers with a more comprehensive suite of information on which to make management decisions. The Bureau of Meteorology discussed the concept of a 'Climate Projections Online' database, which could be a key resource in improving risk management:

> Such a database would have the ability to provide a wealth of information from several models, enabling better estimations of risk than by using one model alone, and hence improve risk management. Such a future climate database is a key to planning adaptation in the longer term for all primary industry and natural resource managers. Such a detailed database has already been developed for the United States.[9]

3.9 Ms Nicolette Boele of the AACC suggested the establishment of an agency to coordinate the types of data farmers will require for making management decisions:

> To give one example, the Bureau of Meteorology is a fabulous organisation that is permanently funded to provide data about weather – and now they have the carriage of some water issues. What we do not have is a bureau of environmental observation and forecasting or something which looks at permanent, ongoing methodologically consistent soil sampling, as an example, across the jurisdictions – a central data repository, something which could even assist in the delivery of drought assistance. It could help farmers with information about the commodities or their sectors, how the soils are changing over time and how the ecosystems are working in their

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7 Senate Rural and Regional Affairs and Transport Committee, *Climate change and the Australian agricultural sector: Interim Report* (Interim Report), September 2008, p. 13.

8 *Committee Hansard*, 1 July 2008, p. 4.

9 *Submission 7*, p. 6.

> areas. We do not have that. We would actually come in line with most [Organisation for Economic Cooperation and Development] countries in having something like that. I have looked at the system in the Netherlands; it could be something we could use here in Australia. That sort of body would be invaluable to helping those agricultural industries … understand what is happening on their land and how they should be changing what they do and over what time period.[10]

3.10 The committee was told of a number of approaches that are available to farmers in order to adapt to changing climate conditions. For the purposes of discussion, the committee has divided these approaches into three categories:

- adapting current farming enterprises to suit new climate conditions;
- building resilient farm management systems; and
- diversifying farming options.

3.11 Each of these strategies is discussed below.

Adapting current farming enterprises to changing climate conditions

3.12 There are a number of adaptive strategies available to agricultural enterprises to assist in adapting to changing climate conditions. Some examples put before the committee include: increasing water use efficiency; selecting cultivars, species and breeds to suit changing climate conditions; and moving production as climate shifts.

Increasing water use efficiency

3.13 Increased competition for water resources means that farming enterprises will need to improve water use efficiency in order to adapt to climate change.[11]

3.14 Horticulture is a prime example of an industry which will need to improve water use efficiency in order to remain viable in a changing climate. The CSIRO highlighted this point in its submission:

> Water demand will increase for most crops growing under warmer conditions. Changes in rainfall and evaporation are likely to reduce soil moisture and runoff in much of southern and eastern Australia. Increased water demand combined with reduced water supply poses significant challenges. Increasing water use efficiency practices will be paramount.[12]

3.15 Improving irrigation systems is one means by which farmers can increase water use efficiency. Members of the committee visited 'Jedburgh' the farm of Scott and Jo McCalman at Warren in western NSW, an area that receives highly variable

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10 *Committee Hansard* , 1 July 2008, p. 23.

11 See for example Mr Ian Bowie, *Submission 2*, p. 5; Queensland Government, *Submission 30*, p. 12; and CSIRO, *Submission 32*, p. 6.

12 CSIRO, *Submission 32*, p. 14. See also: Queensland Government, *Submission 30*, p. 11.

455 mm average annual rainfall which has been well below average for the last seven years. Mr McCalman told members of the committee how water use efficiency at the property had been improved by replacing flood irrigation techniques with the use of an overhead lateral move irrigator. The overhead lateral move irrigator offers a number of advantages over previous flood irrigation techniques, primarily the control in the application of water to a field. While water needs to be applied more frequently with the overhead lateral move irrigator, a smaller volume of water is required. The lateral move irrigator is automated and can be programmed to water at the most advantageous times, such as at night or to supplement rainfall. In addition, as the soil is not being waterlogged, as is the case with flood irrigation, there is less nutrient loss from the soil. Mr McCalman also described how being better able to control water application, and improved water use efficiency, also increased cropping options, for example, with the possibility of introducing crops which are not amenable to flood irrigation. Mr McCalman also noted that at times there are difficulties in regional areas in finding staff, so the fact the overhead lateral move irrigator is automated and reduces staffing requirements is an advantage. Finally, the amount of infrastructure and preparation for putting in crops is greatly reduced with the overhead lateral move irrigator compared with flood irrigation.

3.16 Dr Ian Johnsson of Meat and Livestock Australia, outlined for the committee some of the research work being done to identify genes in plants that assist water use efficiency:

> …we are looking at trying to increase drought tolerance in a number of species, seeing whether we can find gene markers to help select and increase the rate of genetic progress in that area. All of the pasture breeding programs and forage breeding programs in Australia these days have water use efficiency as one of their major selection criteria.[13]

3.17 The committee also notes the evidence of Professor Michael Young of the Wentworth Group of Concerned Scientists:

> I would add a caution around increases in water use efficiency. At the moment we allocate water to water supply systems and to farmers in gross terms. We do not require them to account for the amount they return to a system…When you increase water use efficiency then people use more water.[14]

3.18 Professor Young explained that as irrigators improve water efficiency it stops leaks and seepages back into the system. Inefficient systems may result in half an irrigators' allocation draining back into the system, and, as a result, that water is then available for other downstream users. Improvements in efficiency mean that irrigators

13 *Committee Hansard*, 1 July 2008, p. 11. See also: NFF, Answers to Questions on Notice, 31 July 2008.

14 *Committee Hansard*, 1 July 2008, pp 44-45.

would use all of their water allocation without any being returned to the system, and as a result, downstream users are deprived of the use of that water.[15]

Selecting cultivars, species and breeds to suit changing climate

3.19 A number of submissions highlighted the importance of selecting crop cultivars and species, and livestock breeds which suit new climatic conditions as a means for agricultural industries to adapt to climate change.[16]

3.20 Apple and Pear Australia Limited (APAL) noted that the main adaptive strategy of the pome fruit industry will be to move to fruit varieties with a lower chilling requirement.[17]

3.21 Growcom stated that the number of vegetable cultivars available is an important factor in making vegetable production more adaptable to climate change:

> considerable difference exists in tipping points of fruit versus vegetable production, the many varieties/cultivars and short maturing time of vegetable species makes vegetable production more adaptable to climate change than fruit production.[18]

3.22 The Victorian Department of Primary Industries also noted that changing livestock breeds could be an adaptation option for the livestock industry.[19]

Moving production as climate shifts

3.23 Several submissions discussed the prospects for moving agricultural industries as climatic zones shifted. In general, it appeared that this may be a viable option for some industries, but not necessarily for all agricultural industries. The AACC indicated that some agricultural activities would be able to relocate, effectively moving as the climate does, but they will be in the minority.[20]

3.24 Mr Ian Bowie noted the CSIRO predictions for a southward shift in climate, but stated that there may not be a corresponding shift in agricultural zones:

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15 *Committee Hansard*, 1 July 2008, p. 45.

16 See for example Victorian Department of Primary Industries, *Submission 27*, pp 14-15; and Agricultural Alliance on Climate Change, *Submission 37*, pp 7-8.

17 *Submission 23*, p. 3.

18 *Submission 31*, attachment: Growcom, *Growcom horticulture and climate change workshop report*, 25 January 2008, p. 5. See also: Queensland Government, *Submission 30*, p. 10; and CSIRO, *Submission 32*, p. 14.

19 *Submission 27*, p. 14.

20 *Submission 37*, p. 8, quoting from J. Sherrard, A. Tate and N. Boele: *Agricultural Alliance on Climate Change: Issues Paper*, July 2007. Available at: http://www.climateinstitute.org.au/images/stories/agribusinesspaper.pdf, accessed 12 November 2008.

> …a climatic shift equivalent to Albury coming to have a climate similar to Tamworth's present climate may have little impact on potential temperate pasture production around Albury because potentials for this are already depressed by temperature and moisture limitations.
>
> Similarly …for (the few) areas in the north which have soils and terrain that might be suitable for more intensive agriculture, it appears that even in the limited areas where rainfalls might increase, seasonality will not decrease. The prospects for more intensive agriculture in the north remain very limited and very localised.[21]

3.25 APAL explained in its submission that there was very little scope for the industry to move regions as climate change impinged on its growing areas:

> …the overall effects on horticultural production in Australia may be greater than in many temperate regions of the northern hemisphere due to the marginal nature of some fruit growing areas and the lack of extensive higher altitude or higher latitude regions where chilling requirements may continue to be met under warmer conditions.[22]

3.26 The Queensland Government also noted the impact that warmer temperatures would have on the production of temperate fruits and some vegetables which required winter chilling. While noting that rising temperatures are a constraint to moving horticulture north, the Queensland Government submission did note that there are opportunities in relation to tropical and subtropical crops:

> For tropical and subtropical crops such as avocadoes, mangoes and bananas, increasing temperatures will provide opportunities for production to occur in regions which are currently too cold for economic yields and quality.[23]

3.27 The CSIRO indicated that there is potential for relocation within the viticulture industry:

> The water demand of winegrape vines will increase in a warmer climate while rainfall and, more importantly, runoff to water storages is projected to decrease. Shifting to cooler sites can alleviate some of the warming impact. As vineyards have a life of 30+ years, planning for this should begin now.[24]

Resilient farming systems

3.28 The committee received evidence and submissions about changing farm management practices as a means of agricultural industries adapting to climate change:

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21 *Submission* 2, p. 3.

22 *Submission 23*, p. 3, quoting from an article by Kevin Hennessy of the CSIRO.

23 *Submission 30*, p. 10.

24 *Submission 32*, p. 14.

> Farmers have become much more adept at managing and preparing for extreme conditions, such as drought or floods. They are employing practices which include conservation till, zero or minimal tillage, direct drilling, geo-positioning, stubble retention and a variety of on-farm water management strategies.[25]

3.29 To this end, the committee spent a significant amount of time during this Inquiry investigating the use of perennial cropping and grazing systems as a means of agricultural enterprises adapting to climate change. As the committee learnt, some farmers have been using these systems for many years, but in recent years there has been a growing interest amongst farmers in perennial systems.[26]

Perennial cropping and fodder shrubs

3.30 The committee was told of the potential for perennial systems to improve soil conditions, and hence agricultural productivity. The committee also arranged for subcommittees to visit 'Pine Crest', the farm of Murray, Jenny and Kyle Carson in the Binnu district of Western Australia, and the McCalman's property 'Jedburgh' to see first hand the perennial pastures systems that have been introduced on those properties and to report back to the committee.

3.31 The committee also heard substantial evidence about the potential of these systems as a way of creating permanent carbon sinks from agricultural soils. The potential for agricultural soils is discussed at length in the next section of the chapter on Mitigating and offsetting greenhouse gas emissions.

3.32 The submission of the Australian Soil Carbon Accreditation Scheme (ASCAS) detailed how traditional farming practices have degraded agricultural land and reduced the organic carbon content of soil:

> In little over 200 years of European settlement, more than 70 percent of Australian agricultural land has become seriously degraded. Despite efforts to implement 'best practice' in soil conservation, the situation continues to deteriorate.
>
> On average, 7 tonnes of topsoil is lost for every tonne of wheat produced. This ratio has most likely worsened in recent years due to an increased incidence of erosion on unprotected topsoils, coupled with declining yields.
>
> Over the last 50 years, the organic carbon content of Australian agricultural soils has declined between 50% and 80%.

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25 Westpac Banking Corporation, *Submission 28*, p. 2. See also: Victorian Department of Primary Industries, *Submission 27*, pp 14-15; and Agricultural Alliance on Climate Change, *Submission 37*, pp 7-8.

26 See Mr Bob Wilson, *Committee Hansard*, 30 June 2008, p. 38; Mr Tim Wiley, *Committee Hansard*, 30 June 2008, p. 42; and Dr Christine Jones, Founder of the Australian Soil Carbon Accreditation Scheme, *Committee Hansard*, 30 June 2008, p. 53.

> Soil carbon is the prime determinant of agricultural productivity, landscape function and water quality. Carbon losses of this magnitude therefore have immeasurable economic and environmental implications.[27]

3.33 The ASCAS submission went on to explain how perennial groundcover improves soil conditions and increases the carbon content of soil:

> The soluble carbon exuded into the rhizosphere by perennial groundcover plants and/or transported deep into soil by mycorrhizal fungi, provides energy for the vast array of microbes and soil invertebrates that produce sticky substances enabling soil particles to be glued together into lumps (aggregates). When soil is well aggregated, the spaces (pores) between the aggregates allow the soil to breathe, as well as absorb moisture quickly when it rains. A healthy topsoil should be 'more space than stuff'…[28]

3.34 Mr Bob Wilson provided evidence to the committee about his own experience in working with perennial species in Lancelin in Western Australia:

> As a farmer, in 1985 I realised that the traditional annual based agricultural system that we were working with was failing. I moved to trial some new and innovative perennial systems that were based around a fodder shrub called tagasaste, which is a deep rooted perennial shrub. Over a period of years we planted around 1,000 hectares on the farm. By 2003 we started planting some subtropical perennial grasses, again to try and adapt what was happening with our past system so as to move from an annual based system to a more perennial based farming system.[29]

3.35 Mr Tim Wiley provided evidence to the committee about preliminary work being done in the Binnu district of Western Australia comparing perennial pasture systems to annual systems:

> We had a project that started in 2006 in the Binnu area, the worst affected area, where we got the farmers to record the actual stock movements so we could work out exactly how much each paddock carried for a 12-month period. We picked farmers who were just starting to put in the perennials – the first innovators. It turned out to be the mother of all droughts. What that data said was that it did not matter what we did, any traditional annual pasture would not have grown enough to prevent the wind erosion we saw over the 10-month period. Even I was surprised how good the perennials were. We were actually carrying four to six sheep per hectare equivalents and had ground cover and had no erosion. So these innovations carried more stock in the worst drought ever than those farmers carried on annual pastures in a normal year. That gives us hope for the farmers but even for me. The only thing that kept us sane during that drought was to go out and see those patches of green.

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27 *Submission 42*, p. 2.

28 *Submission 42*, p. 3.

29 *Committee Hansard*, 30 June 2008, p. 38.

> One of the other innovations we did only last year was to do with approaches to cropping. There is a farmer over here doing pasture cropping and growing wheat over these summergrowing perennial pastures…I came over and saw it last year and we went back and put a trial in and, remarkably, we found that the wheat on certain perennials out-yielded the wheat on annual pastures.[30]

3.36 The committee also notes the work by Scott and Jo McCalman on their property, 'Jedburgh' in Warren, NSW, an ASCAS soil monitoring site:

> … that farm had been conventionally zero tilled for 15 years prior to the rain this summer. It was then miraculously covered in perennial grasses that just appeared. Scott McCalman … decided that he was not going to kill his grasses, that he was actually going to crop into them. He had heard about pasture cropping, and he just decided that he was going to do that. He saved $70 a hectare by not spraying out those grasses. When we measured the nutrient levels in his paddock this year prior to him sowing his crop, the phosphorous levels had gone up by a factor of five. The agronomist actually thought there was a laboratory error in the data. We relooked at that and at bare areas compared with areas under the grass, and it was correct that available phosphorous had gone up by a factor of five.
>
> … Phosphorous fertilisers had been used over time, under 15 years of zero till in that area, and they just formed a phosphorous bank that had been inaccessible.[31]

3.37 The committee also heard evidence from Mr Kevin Goss of the Future Farm Industries Cooperative Research Centre (Future Farm Industries CRC) on the work that organisation is doing investigating the role of perennial plants in cropping and grazing systems, and also the potential for new woody crops:

> We are well advanced with a prime lamb livestock production system called EverGraze, which is for the high rainfall environments…between 500 and 600 millimetres…we bring in perennial pasture plants in unique combinations – including perennial legumes, summer active perennial grasses, winter active perennial plants like chicory – we bring in much improved animal genetics capable of lambing percentages way above current levels and we introduce a tall perennial grass or shrub to provide a much better nursery environment for the many more lambs that are involved so that we do not see the deaths of twins and triplets. The management system is a much tighter rotation that matches the livestock's

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30 *Committee Hansard*, 30 June 2008, pp 39-40. The Binnu area has hot summers and mild winters (a Mediterranean climate). The area has long term average annual rainfall from 400mm on the coast to 275mm on the eastern fringe. Winter rainfall is dominant, and summers are mostly dry, but can occasionally be wet. There are strong winds regularly in summer, autumn and early winter.

31 Dr Jones, *Committee Hansard*, 30 June 2008, pp 45-46. 'Jedburgh' is in north-west NSW. The region has a highly variable 455 mm average annual rainfall, which has been well below average for the last seven successive years.

> nutritional requirements with the feed availability… Our benchmarking in western Victoria demonstrates that it is running at about 50 per cent above best practice in production in the district and it is also making a major reduction in leakage to groundwater in that environment, which is a very good thing from a dryland salinity viewpoint.[32]

3.38 Mr Goss also told the committee about two other programs that the Future Farm Industries CRC is conducting: EverCrop, which is looking at the introduction of drought tolerant perennials in the non-crop phase of a cycle; and Enrich, which is looking at the potential of new perennial forage plants on marginal soils where cropping is probably not going to be an option.[33]

3.39 Meat and Livestock Australia indicated to the committee that it is investing in research in pasture management systems, and particularly perennial pastures because of the sustainability of those systems.[34]

3.40 The committee was told of the success of perennial grasses in areas of low rainfall:

> Our crop yields are the same or better than under conventionally managed farming, and the improvement in yield is better the more marginal the area because perennials provide so much change to soil biology.[35]

3.41 The committee also heard evidence that perennial pasture systems are likely to reduce the need for herbicides:

> …most of these crops are grown with no herbicide whatsoever because perennial grass prevents weeds from coming through; you have complete ground cover. The better the ground cover, the better the crop. So we find that the thicker the perennial grasses, the more vigorously they grow, the more they condition the soil and the better the crop grows – that is, the annual crop that you plant into the perennial pasture.[36]

3.42 Mr Goss of the Future Farming Industries CRC also noted the benefits of using legumes in perennial pasture systems as a means of improving the nitrogen content of soil:

> In the wheat belt we have started a program called EverCrop…it is particularly looking at broadening the footprint of legumes, which we increasingly see as being important because farmers at some point may

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32 *Committee Hansard*, 30 June 2008, pp 85-86.

33 *Committee Hansard*, 30 June 2006, p. 86.

34 Dr Ian Johnsson, General Manager, Livestock Production Innovation, Meat and Livestock Australia, *Committee Hansard*, 1 July 2008, p. 11.

35 Dr Jones, *Committee Hansard*, 30 June 2006, p. 43. See also: Dr Jones, *Committee Hansard*, 30 June 2008, p. 49.

36 Dr Jones, *Committee Hansard*, 30 June 2008, p. 43. See also: Mr Wiley, *Committee Hansard*, 30 June 2008, p. 42.

> have to substitute legume generated nitrogen to some extent for applied nitrogen if oil prices stay the way they are.[37]

3.43 When questioned as to the challenges presented by perennial pastures systems, the committee received the following impressive response from Dr Jones:

> I am going to give you an emotional response and say that for some of the farmers I have worked with it is almost like a love affair, because they get so excited. They send me amazing emails saying: 'Christine, you would not believe what is happening on our place. We are so excited and we have not been this happy for a long time.' …We have now got children in a lot of these families going out and collecting grasses that they find on the side of the road and sending them to me in the mail to ask what they are because they want to plant them on the farm. They say: 'Will this be good for Dad to plant wheat into? Is this one a weed or is it a good grass?'[38]

3.44 Mr Wiley emphasised that one of the real issues for farmers wanting to introduce these systems is the input costs:

> We see some hope and systems that could work in the future. The problem is finance – the equity is shot; the banks' nerves are shot. So if these things work, how do we actually redevelop agriculture? How do we fund it? I cannot see that government would pay the bill for what is required to totally redevelop agriculture even in our little part of the world.[39]

Diversifying agricultural enterprises

3.45 Another option for farmers to adapt to climate change is to diversify their enterprises to provide more options in the face of climate change. One example of diversification that the committee received evidence on is the role that forestry can play as part of an integrated agricultural enterprise.

Forestry

3.46 The submission from the National Association of Forest Industries (NAFI) described the forestry industry as generally less susceptible than other agricultural enterprises to climatic variation:

> At the landscape level, forestry can provide a valuable complementary land use to other forms of agriculture, which may be at greater risk from the effects of climate change. As a long term crop, trees are generally not as susceptible to seasonal and long term climatic variations as certain types of agriculture.

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37 *Committee Hansard*, 30 June 2008, p. 86.

38 *Committee Hansard*, 30 June 2008, p. 53.

39 *Committee Hansard*, 30 June 2008, p. 40. Chapter 4 discusses the potential for sequestration of carbon in soil as a means of financing these input costs.

> Recent drought conditions throughout Australia have resulted in dramatic reductions in agricultural production, yet the level of impact on production forestry has been far less severe.[40]

3.47 The Victorian Department of Primary Industries detailed the benefits that forestry may have in improving the adaptive capacity of agricultural enterprises:

> Adaptive capacity can be enhanced through synergies between forestry and agricultural land uses. For example, shelterbelt tree planting can reduce heat stress for livestock and climatic exposure for pastures and crops, and tree canopies can provide a feed source for livestock during the summer months and drought conditions, usually as a last resort.[41]

3.48 NAFI's submission outlines other benefits of using plantations as a complement to agricultural industries:

> The strategic placement of plantations on farms can lower saline water tables to limit salt loading into watercourses, as well as to filter and absorb excess nutrients from other agricultural activities (i.e. dairying and cropping) prior to entering waterways. The deep rooted characteristics of plantations established in appropriate locations on the farming landscape, is a key tool in managing stream water quality.[42]

3.49 The committee notes that the National Association of Forest Industries' claims in relation to susceptibility to climate variation did not adequately acknowledge the water interception of plantations, the impacts of plantations on ground water or the water needs in plantation establishment as reasons to support their claim. The committee is concerned about the impact that forestry plantations will have on water run-off in catchment areas and the committee notes the evidence of Mr David de Jongh of NAFI, that in terms of the CSIRO's research on salinity impact and water uptake, the best accepted convention on the proportion of a catchment that should be planted under trees before it affects water run-off is 20 per cent.[43]

3.50 Committee members are also concerned about the potential competition between forestry and agriculture in the design of an emissions trading scheme. This issue is discussed in Chapter 4 of the report.

Other diversification options

3.51 The submission of Mr Tim Wiley and Mr Bob Wilson described research the Western Australian Department of Agriculture is undertaking into the potential of diversified farm enterprises in the north east wheat belt of Western Australia:

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40 *Submission 6*, pp 1-2. See also: A3P, *Submission 9*, p. 3.

41 *Submission 27*, p. 15.

42 *Submission 6*, p. 3.

43 *Committee Hansard*, 30 June 2008, p. 110.

> Caroline Peek and Megan Abrahams from DAFWA in Geraldton have been modelling the economic consequences of climate change on a north east wheat belt farm…They find that cropping will not be commercially viable in the near future under the climate change predicted.
>
> …Abrahams et al also considered alternative enterprises that could keep farms profitable. Their modelling suggests that a grazing enterprise based on fattening and trading station cattle could be economically viable if the stocking rate and animal growth rates were high enough…
>
> Abrahams et. al.…also analysed future farming systems that included oil mallees, carbon trading and opportunistic cropping in wetter years as well as station cattle…All of these enterprises can contribute to improving farm profit. However cattle production is the main driver of profit.[44]

3.52 Another option for diversification could be the development of farming enterprises around alternative energy generation. This is discussed later in this chapter in the section on 'Alternative energy sources'.

Mitigating and offsetting greenhouse gas emissions

3.53 The mitigation and offsetting of greenhouse gas emissions also presents a number of opportunities and challenges for the Australian agricultural sector. This section of the report gives a brief background on the amounts and types of agricultural emissions and then goes on to discuss some of the options in relation to mitigating those emissions, as well as offsetting emissions from the agricultural sector and other sectors within the economy.

Greenhouse gas emissions from the agricultural sector

3.54 In 2006, Australia's net greenhouse gas emissions were 576.0 million tonnes of CO_2-equivalent (Mt CO_2-e). The agricultural sector was the second largest source of greenhouse gas emissions, contributing 15.6% of emissions. Land use, land-use change and forestry sectors contributed 6.9% to Australian's greenhouse gas emissions. Compared to other countries, the Australian agricultural and forestry sectors make a relative large contribution to total net greenhouse gas emissions.[45]

3.55 The Kyoto Protocol to the United Nations Framework Convention on Climate Change breaks agricultural emissions down into six sources: enteric fermentation in livestock; manure management; rice cultivation; agricultural soils; prescribed burning of savannas; and field burning of agricultural residues.

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44 *Submission 41*, pp 10-11.

45 See Department of Climate Change, *Carbon Pollution Reduction Scheme Green Paper* (Green Paper), July 2008, p. 95, citing Department of Climate Change, *Australia's National Greenhouse Accounts*: *National Greenhouse Gas Inventory 2006*, June 2008. The energy sector was the largest source of greenhouse gases contributing 69.6% of emissions.

3.56 Agriculture is the dominant source of methane, primarily from livestock (enteric fermentation and manure management), and nitrous oxide, mainly from agricultural soils. In 2006, there was 69.8 million tonnes of carbon dioxide equivalent (Mt CO_2-e) of methane emissions from agricultural sources. These emissions accounted for 59.0% of Australia's net methane emissions. In 2006, there was 20.3 Mt CO_2-e of nitrous oxide emissions from agricultural sources accounting for 83.9% of Australia's net nitrous oxide emissions.[46]

3.57 The Green Paper outlines how agricultural emissions are highly variable in response to management strategies:

> For example, cattle breeds and feed types in tropical and subtropical regions differ from those in temperate regions, and have methane conversion rates that are significantly different. Nitrous oxide emissions from soils in major cereal-growing regions vary geographically and over time, according to different rainfall, soil types and fertiliser application rates.[47]

3.58 The committee was provided with evidence of the potential for the agricultural sector to mitigate its emissions, and also opportunities for offsetting emissions from agriculture and other sectors. These opportunities, and some associated challenges, are discussed below.

Mitigating agricultural emissions

3.59 The joint submission of the Department of Agriculture, Fisheries and Forestry (DAFF) and the Department of Climate Change (DCC) indicated that the Australian Government is funding research in the area of mitigation of agricultural emissions:

> Through the *Greenhouse Action in Regional Australia* (GARA) program, established in 2004, DCC has provided leadership and coordination for greenhouse action in agriculture and land management. About $25 million has been spent over five years to support development of methods and technologies for measuring greenhouse emissions from agriculture and, in partnership with industry, to identify and support implementation of cost-effective abatement strategies.
>
> The GARA program has facilitated strategic climate change research to build the capacity of the agricultural and land management sectors to manage greenhouse gas emissions and response to climate change. Research areas include livestock and emissions from soils, emissions from savannas and forests, and climate change responses in farming systems and natural resource management.[48]

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46 Department of Climate Change, *Australia's National Greenhouse Accounts*: *National Greenhouse Gas Inventory 2006*, June 2008, p. 12.

47 Green Paper, p. 123.

48 *Submission 34*, p. 13.

3.60 In evidence to the committee, Ms Nicolette Boele of the Agricultural Alliance on Climate Change (AACC), referred to some preliminary results from studies showing over a 25 per cent reduction in methane output in sheep eating saltbush. The committee notes Ms Boele's comment that the work is yet to be peer reviewed.[49]

3.61 The submission of the Victorian Department of Primary Industries outlined the work of the 'Greenhouse in Agriculture' program, which is 'an ongoing program of research, development and extension aimed at delivering measurable abatement of methane and nitrous oxide from farming systems in Victoria, whilst maintaining profitable and viable production systems':

> This program has already made significant breakthroughs in developing more accurate benchmarks for agricultural emissions of methane and nitrous oxide. Mitigation opportunities for the dairy farm sector now being verified include selective cattle breeding, use of dietary supplements and extended lactation management.[50]

3.62 In a joint submission, the Cattle Council of Australia and Meat and Livestock Australia (MLA), were cautious as to the overall effect that research into the mitigation of agricultural emissions would have:

> MLA is supporting research into mitigation of emissions of methane from livestock and nitrous oxide and methane from animal waste, but the options are likely to take considerable time to operationalise, produce relatively small reductions, and be costly.[51]

3.63 The committee is also aware of the discussion in The Garnaut Climate Change Review about the potential for a reduction in agricultural emissions through shifting of meat production from sheep and cattle to kangaroo, which emit negligible amounts of methane through enteric fermentation.[52]

3.64 Voiceless provided the committee with a submission outlining the role that increasing global meat consumption plays in contributing to climate change:

> It has recently been observed that while coal is often seen as the major threat to the environment, it is actually cattle that will have the biggest impact on the climate during the next 20 years…
>
> The livestock sector has emerged as one of the most significant contributors to the more serious environmental problems, with farmed animals now producing more greenhouse gas emissions than the world's entire transport system.[53]

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49 *Committee Hansard*, 1 July 2008, p. 18.

50 *Submission 27*, p. 26.

51 *Submission 36*, p. 5.

52 Professor Ross Garnaut, *The Garnaut Climate Change Review: Final Report*, 30 September 2008, p. 547-8. See also: Mr Ian Bowie, *Submission 2*, p. 4.

53 *Submission 11*, p. 5.

3.65 Voiceless' submission concluded that 'only a reduction in meat consumption and intensive livestock production can effectively address the issue of global warming and slow the pace of climate change'.[54]

3.66 While Voiceless makes valid points in relation to the impacts that livestock production and meat consumption has on increasing greenhouse gas emissions, calls to reduce meat consumption obviously concern those in the agricultural sector. MLA made the following submission on the impacts of decreased meat consumption:

> A shift away from meat-based diets towards vegetable-based diets will have important ramifications for the economic viability of livestock producers and processing industries. It will also have impacts on landscape health if more fragile lands are cropped rather than grazed, especially under irrigation. There is also good evidence that a decline in intake of the nutritional benefits of meat will have long-term implications for health.[55]

Soil Carbon Sequestration

3.67 In its consideration of evidence and submissions about perennial pasture and fodder systems, the committee was particularly interested in the potential of these systems to act as permanent carbon sinks through the sequestration of carbon in the soil. The committee received evidence from a number of witnesses who are very enthusiastic about the potential of agricultural soils to act as a carbon sink. However, the committee notes there appears to be little support in the scientific community.

3.68 Dr Mark Howden of the CSIRO, while noting that there was no 'single CSIRO view' of soil carbon sequestration, was cautious as to prospects of soil carbon sequestration:

> Soil carbon is essentially a function of how much carbon goes into the system, so it is really a function of the ecosystem production, and how much goes out of the system, which is a function of various breakdown rates, degradation rates – which can be caused by people using, say, windrowing or burning, or just part of natural processes. The balance between those is what is left in the system, and that is the soil carbon. It can go up or go down. We know with a great deal of certainty that certain conversions of agricultural land from one form to another have significant carbon implications in the soil. Within each land use, the flexibility to improve carbon content is often small, but sometimes it can be larger. There is a need to be cautious about the prospects for incorporating soil carbon into some systems, because that carbon can be quite labile, which means it can be easily lost, and there can be significant overestimates of how much carbon can be incorporated into agricultural systems as well.[56]

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54 *Submission 11*, p. 6.

55 *Submission 36*, p. 5.

56 *Committee Hansard*, 30 June 2006, p. 19.

3.69 According to Dr Jones of ASCAS, soluble carbon entering soil from plant roots is rapidly humified if appropriate microbial associations are in place, and this humified carbon is not labile and is not easily lost.[57] Dr Jones went on to explain to the committee how conventional cropping inhibits the sequestration of carbon in soil:

> What happens in a conventional zero-till type cropping is you would have stubble that would break down into the soil and form what they call labile carbon, which is very readily decomposed, and within 12 to 18 months most of that goes back to the atmosphere as carbon dioxide. So it is a very rapid cycling of carbon, and the reason that that happens is that the microbes necessary for humification are not there because the chemicals used in zero till have knocked them out of the system. This is why we have experts across Australia telling us we cannot build soil carbon because they are looking at conventional zero-till systems where the microbes that you need to build the carbon simply are not there. They are actually quite correct that you cannot build carbon in those systems. But if we go to perennial based agriculture and change the soil biology and get the microbial associations, we can build carbon at rates faster than people will actually acknowledge is possible.[58]

3.70 In terms of how governments view the potential of this area, the joint submission of DAFF/DCC states that 'the management of soil carbon is one opportunity that requires further research'.[59] To this end, in March 2008 the Prime Minister announced that the Federal Government would be investigating soil carbon as part of the *Australia's Farming Future* initiative.[60] In contrast, the assessment in the Green Paper of the potential of sequestration of soil carbon in agricultural soils is more muted:

> There are likely to be important opportunities to increase the carbon stored in agricultural soils. However, scientific research conducted in Australia suggests that, while there are opportunities for increasing and retaining agricultural soil carbon, Australia does not have the same sequestration potential as other countries, and there is significant risk of loss of soil carbon in times of drought or changed management practices. Nevertheless,

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57 *Committee Hansard*, 30 June 2008, p. 41.

58 *Committee Hansard*, 30 June 2008, p. 44.

59 *Submission 34*, p. 7. See also: Mr Jim Groves, General Manager, Climate and Resource Policy, Queensland Department of Primary Industries and Fisheries, *Committee Hansard*, 1 July 2008, p. 66.

60 The Hon. Kevin Rudd, Prime Minister of Australia, *Address to the ABARE Outlook 2008 Conference*, 4 March 2008, p. 5. Available at: http://www.abare.gov.au/interactive/Outlook08/files/day_1/PMrudd_opening.pdf, accessed 22 November 2008. See also: Dr Colin Grant, Executive Director of the Bureau of Rural Sciences (BRS) *Committee Hansard*, 1 July 2008, p. 90, who indicated that BRS, in conjunction with CSIRO were in the process of producing a report evaluating work being done across the world in terms of soil carbon and to identify the issues associated with soil carbon.

> Australia should continue to investigate opportunities for improving soil carbon retention…[61]

3.71 In their submission and in evidence to the committee Mr Wiley and Mr Wilson provided some preliminary data they have about the ability of agricultural soils to sequester carbon. Soil carbon sequestration by perennial pasture systems has been calculated to be 5-10 tonnes CO_2-equivalent/hectare/year (CO_2-eq/ha/yr), compared to sequestration of less than 1.5 tonnes CO_2-eq/ha/yr by annual systems.[62]

3.72 In evidence to the committee Mr Wiley acknowledged that he was 'not totally certain' that this data was correct:

> …we are right at the point at trying to collect good, vigorous, scientific data to find out whether we are really right although I myself have some uncertainty about that. Once we have that data, that will create a whole pile of challenges for the scientists to try to figure out how it is happening.[63]

3.73 Dr Jones also gave evidence to the committee that in some areas the sequestration of carbon by soils was 'far more' than could be sequestered in trees. Further, the perennial pastures had an advantage over trees as a carbon sink because it could be grown in 'marginal areas' where trees would not receive sufficient rainfall to grow.[64]

3.74 When questioned about the response from the scientific community about these findings, Mr Wiley noted that he has had discussions with a scientist at CSIRO who indicated a willingness to further investigate what is occurring with perennial pastures in Western Australia in terms of the amount of carbon being sequestered.[65] In contrast, Dr Jones told the committee she had been applying for funding in this area for at least 10 years:

> I have folders full of reject letters saying that it was an extremely well worded application, that it has possibility but the current science does not support it and it is not possible to actually increase carbon to the levels that we were documenting on farm. I would have to say that that has changed very quickly recently. In fact in the last week even, there have been huge changes. I think we have just finally got to the tipping point. We have 2,000 farmers involved in this. It is a huge grassroots revolution that the scientific

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61 Green Paper, p. 121.

62 See *Submission 41*, p. 15; and Mr Wiley, *Committee Hansard*, 30 June 2008, p. 40. Information on the sequestration rates of perennial pastures compared with annual pastures was also presented to the subcommittee on its visit to the Binnu district of Western Australia. See also: Dr Jones, *Committee Hansard*, 30 June 2008, p. 41.

63 *Committee Hansard*, 30 June 2008, pp 40 and 42.

64 *Committee Hansard*, 30 June 2008, p. 43.

65 *Committee Hansard*, 30 June 2008, p. 42.

> establishment for some reason seems to be completely unaware of or, if they are aware of it, have totally discounted as irrelevant.[66]

3.75 Dr Michael Robinson of Land & Water Australia, and Chair of the Joint Strategy Team of the National Climate Change Research Strategy for Primary Industries (CCRSPI), told the committee that the CCRSPI process had identified approximately 26 research projects that are directly related to soil carbon, however, those projects are part of a broader suite of work around agricultural production and sustainability, and carbon accounting or nitrous oxide emissions.[67]

Alternative energy sources

3.76 The committee received some evidence as to the role that the agricultural sector could play in the production of alternate energy sources as a means of reducing emissions from other sectors of the economy. Much of the evidence considered by the committee related to the role of biofuels and the impacts that this would have on food production.

Biofuels

3.77 Submissions highlighted the potential for biofuels production in Australia. The Agricultural Alliance on Climate Change (AACC) referred the committee to research it had commissioned the CSIRO to undertake. The resulting report, *Rural Australia providing climate solutions*, made the following comments on the expected expansion of biofuel production in Australia:

> Biofuel supply is expected to exceed … 350ML by 2010, and significant further expansion of domestic biofuel production in the medium term would be possible with step changes in production technologies or specific policy action in addition to the introduction of emissions trading. Realising the benefits of increased production and use of biofuels will require all stakeholders to be involved in developing practical pathways for commercialising biofuels that are environmentally sustainable and do not disrupt food and fibre production, along with significantly increased research and development into prospective second generation biofuels that are relevant to Australia…[68]

3.78 This statement touches on the concerns raised in submissions about the expansion of biofuel production, specifically the delicate balance between production for food and fibre and production for biofuels. The Australian Landcare Council noted this challenge in its submission:

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66 *Committee Hansard*, 30 June 2008, p. 47.

67 *Committee Hansard*, 30 June 2008, p. 59.

68 Agricultural Alliance on Climate Change, *Rural Australia providing climate solutions*, October 2007, p. 5. See also: Victorian Department of Primary Industries, *Submission 27*, p. 16.

> The role of biofuels in [greenhouse gas] strategies presents some challenges to policy makers. Dedicated agricultural production of biofuel feedstocks can compete with food production with resultant upward pressure on food prices, leading to social and economic impacts. Secondly, whole-of-lifecycle analyses often reveal little net emissions benefit from existing biofuel production systems.[69]

3.79 The Sydney Centre for International Law outlined concerns in relation to mitigation of climate change, and the impact that this might have on food production:

> Australia must be cautious not to aggravate other serious international problems through its mitigation measures. For example, the World Bank recently reported that global food prices rose by 83% in the past three years, in part due to demand for bio-fuels and the consequent conversion of food crops to energy crops, driving up basic food prices. The consequence is chronic food insecurity in some parts of the developing world, which both infringes the basic human right to food, and generates social and political instability and even violent conflict.[70]

3.80 In response to a question on notice, the CSIRO provided the following information about the expansion in global biofuel production:

> [Organisation for Economic Cooperation and Development-Food and Agriculture Organisation of the United Nations] estimates of world wheat and coarse grain (maize, sorghum, barley and oats) production for 2007 amount to 1,661 million tonnes. Of this 761 million tonnes was used for feed and industrial purposes, including an estimated 93 million tonnes for biofuels (dominated by maize in the USA). In other words, approximately 6% of wheat and coarse grain was used for biofuels in 2007. World production of rice amounted to 660 million tonnes in 2007 and no diversion of rice to biofuels is taking place – hence overall percentage of grain (wheat, rice and coarse grains) going to biofuels appears to be approximately 4% in 2007.
>
> In terms of rates of growth in grain demand, biofuels are an important driver. Wheat and coarse gain usage globally is estimated to have increased 80 million tonnes between 2005 and 2007. Over this time, biofuel use of grain increased by 47 million tonnes, amounting to approximately 60% of the increased global wheat and coarse grain consumption.[71]

3.81 The submission provided by A3P, the peak body for Australian plantation, plantation products and paper industries, and representatives from the National

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69 *Submission 13*, p. 4. See also: Queensland Government, *Submission 30*, p. 7.

70 *Submission 39*, p. 5.

71 Answers to Questions on Notice, 23 July 2008.

Association for Forestry Industries highlighted the role that forests could play in biofuel production.[72]

3.82 A3P pointed out in its submission that using plantation products could avoid the 'perverse outcomes associated with other biofuel opportunities such as more intense harvesting or conversion of natural forests, reduced food production, or reduced fibre for timber and paper production.'[73]

3.83 However, the committee also received evidence from Dr Mark Howden of the CSIRO stating that there is a 'technological hurdle' to be overcome in relation to using wood products for biofuels, namely the lignocellulosic breakdown of wood products to produce ethanol or similar products. Dr Howden indicated that, to his knowledge, no research is currently being undertaken in Australia to overcome this 'technological hurdle'.[74] The committee is also aware that conversion of native forests is still practised in some parts of Australia and biofuel production may pose the same risks domestically as it does overseas.

3.84 The committee also notes the comments of Associate Professor Christopher Preston of the Cooperative Research Centre for Australian Weed Management, in relation to the 'weediness' potential of prospective biofuel crops.[75]

Other forms of alternative energy generation

3.85 The committee was disappointed that it received very little evidence or submissions about the potential for using agricultural land as a means of 'farming' alternative energy sources.

3.86 The AACC's paper, *Rural Australia providing climate change solutions*, states that '[r]enewable energy offers significant financial and other benefits to landholders and rural communities'. The report goes on to speculate on the value of renewable energy:

> Previous reports imply wind and bio-electricity could generate total annual revenues of $300-1000 million by 2020 with an ambitious emissions reduction target or other policy support for renewable energy. Estimates undertaken for this report suggest potential wind royalties of up to $150 million a year, or more.[76]

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72 A3P, *Submission 9*, p. 5; and Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Committee Hansard*, 30 June 2008, p. 102.

73 *Submission 9*, p. 5.

74 *Committee Hansard,* 30 June 2008, pp 5, 19-20.

75 *Committee Hansard*, 30 June 2008, p. 94. This issue was discussed in Chapter 2.

76 Agricultural Alliance on Climate Change, *Rural Australia providing climate change solutions*, October 2007, p. 4.

3.87 The committee questioned Dr Mark Howden of the CSIRO as to the whether in its research the CSIRO is looking at wind and solar thermal energy options as a feasible farming option. Dr Howden indicated that he had spoken to farmers about this issue and that some were 'thinking constructively along those lines'.[77]

3.88 The joint submission from the Department of Agriculture, Fisheries and Forestry and the Department of Climate Change provided information on the *Methane to Markets Program*, which 'seeks to lower agricultural greenhouse gas emissions by capturing and using methane for energy generation':

> The program will adapt for Australian conditions technology already in use in intensive animal production in a number of other countries, including he United States, the United Kingdom and Canada. The captured methane generated from the waste can be used for industrial heating and drying or, alternatively, for electricity generation to supply power grids.[78]

Committee view

3.89 The committee was pleased to hear about the many potential opportunities that climate change may present to the agricultural sector, particularly in relation to issues such as perennial pastures and soil carbon sequestration. However, the committee is also concerned about the many challenges presented to the Australian agricultural sector by climate change, not least in terms of competition for water resources and reduced water availability.

3.90 The committee is very concerned about what it perceives to be a disconnect between the Australian agricultural sector and those in the scientific area. The committee noted this disconnect in its Interim Report in relation to the communication of climate projections. The committee heard evidence about the 'very strong relationship' that farmers have with the land, and its natural cycles.[79] For this reason, the committee is disappointed that, at times, it appears that the scientific community and the Government take a dismissive view of adaptation and mitigation possibilities which have strong support in the agricultural sector. The committee urges those researching and investigating climate change adaptation and mitigation opportunities and risks to fully engage with those in the agricultural community.

Recommendation 1

3.91 The Government should significantly increase the research effort in relation to the potential of soil carbon as a climate mitigation measure, as a

77 *Committee Hansard*, 30 June 2008, p. 5.

78 *Submission 34*, p. 15.

79 Ms Nicolette Boele, Director, Strategic Projects, Agricultural Alliance on Climate Change, *Committee Hansard*, 1 July 2008, p. 24. See also: Mr Ben Fargher, Chief Executive Officer, NFF, *Committee Hansard*, 1 July 2008, p. 26.

means of reducing the capital input costs to agriculture as a means of increasing resilience in agricultural systems.

Chapter 4

The impact of an emissions trading scheme for the Australian agricultural sector

Introduction

4.1 The impact of an emissions trading scheme on the Australian agricultural sector was a particular point of concern raised in submissions and evidence during the course of the Inquiry. The committee received numerous submissions about the design and coverage of an emissions trading scheme, and specifically the methodology for accounting for agricultures emissions and removals of greenhouse gases was a source of much debate throughout the inquiry.

4.2 This chapter begins with a discussion of the Government's Carbon Pollution Reduction Scheme (the Scheme) proposal and then moves on to discuss some of the concerns raised in relation to an emissions trading scheme and the agricultural and forestry sectors. All submissions to the Inquiry were received prior to the announcement of details of the Scheme. For this reason, some of the issues in this chapter are not discussed in the context of specific proposals in the Scheme.

The Carbon Pollution Reduction Scheme

4.3 In July 2008, the Australian Government released its Green Paper on the Carbon Pollution Reduction Scheme (Green Paper), which outlines the Government's approach to the design of a national emissions trading scheme.[1] The Carbon Pollution Reduction Scheme (the Scheme) will be a 'cap and trade' scheme. According to the Green Paper this will create a carbon price and ensure that emissions are reduced at the lowest possible cost.[2]

4.4 Although the Green Paper does not address the levels of the caps in the Scheme, the Government has indicated that the caps will be 'consistent with the Government's commitment to reduce national emissions by 60% of 2000 levels by 2050'.[3]

4.5 The Green Paper states that the Scheme should have 'maximal practical coverage of greenhouse gas emissions and sectors':

> Broad scheme coverage is a key element in reducing the overall cost to the Australian economy of achieving emissions reductions. Broad coverage

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1 See Department of Climate Change, *Green Paper on the Carbon Pollution Reduction Scheme* (Green Paper), July 2008, p. 1.

2 Green Paper, p. 12.

3 Green Paper, pp 11-12.

> will increase opportunities for low-cost emissions reductions and ensure that the cost of achieving those reductions is shared as equitably as possible across the economy. Broad coverage will also ensure that competing firms and sectors operate within equivalent market conditions.[4]

4.6 However, the Government acknowledges that there are practical limitations to broard coverage by the Scheme, notably compliance costs and the capacity to estimate emissions in an unbiased manner.[5]

4.7 The Green Paper identifies several characteristics of agriculture emissions which create difficulties for including agriculture in the Scheme. As was noted in Chapter 3, agriculture emissions vary in response to management practices and climatic conditions. In addition, the agricultural sector has a large number of entities with relatively low emissions, that is, less than one kilotonne of carbon dioxide equivalent per year.[6]

4.8 The Green Paper states that the Government is disposed to include agriculture emissions in the Scheme by 2015 and to make a final decision on this issue in 2013.[7] The Green Paper does note that in the event that coverage of agriculture emissions in the Scheme proves impractical, the Government will consider alternative mitigation measures, for example: mandatory adoption of emissions standards, certain low-emissions technologies or management practices. However, the Green Paper notes that such measures are 'unlikely to be as cost effective as market-based approaches such as emissions trading and are likely to increase overall abatement costs'.[8] The Green Paper also notes that offsets are another mechanism that could provide firms in uncovered sectors to undertake abatement, however:

> By their very nature … offsets assist other sectors to meet their emissions obligations, rather than providing a means by which a sector contributes to national emissions reductions.[9]

Accounting for greenhouse gas emissions and removals

4.9 In the event that agriculture were to be covered by an emissions trading scheme, the accounting framework will be important because it determines which

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4 Green Paper, p. 15.

5 Green Paper, p. 96.

6 Green Paper, p. 123. See also Department of Agriculture, Fisheries and Forestry and Department of Climate Change, *Submission 34*, p. 11. The Green Paper states that, in general, the emissions threshold for direct obligations under the scheme would apply to entities with facilities which have direct emissions of 25 kilotonnes of carbon dioxide equivalent a year or more, see p. 98.

7 Green Paper, p. 126.

8 Green Paper, pp 91, 123 and 138.

9 Green Paper, p. 91.

agricultural emissions and sinks will be counted in an emissions trading scheme and those which will be excluded.

4.10 Australia has obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and under the Kyoto Protocol to the UNFCCC (Kyoto Protocol) for monitoring and reporting its greenhouse gas emissions.[10]

4.11 Ms Margaret Blakers explained to the committee the differences between the UNFCCC and Kyoto Protocol accounting frameworks for greenhouse gas emissions estimates:

> … the Intergovernmental Panel on Climate Change – sets the methodology. It says how to measure the carbon. Then there are two ways of reporting the accounts. One is the Kyoto reporting and the other one is what is called UNFCCC accounting. That is attempting to be more like a full carbon accounting report.
>
> The Kyoto accounting is a partial report. … It looks only at land use change, in particular at land use change that relates to forests, because the assumption was that that was where the biggest emissions and uptake would happen. So, for example, it does not look at soil carbon, it does not look at degradation of rangelands and it does not look at logging native forests.
>
> The UNFCCC account is more comprehensive. It does look at logging native forests. It still does not look, in the way that it is done in Australia, at soil carbon, rangelands or any kind of non-forest vegetation. In the Australian version it does not even look at conservation land. That is not counted. It does not look at wetlands, for example. So even the UNFCCC accounting … is not yet anything like full carbon accounting, particularly the way in which it is implemented in Australia.[11]

4.12 The Green Paper states that the Government's preferred position in relation to accounting under the Carbon Pollution Reduction Scheme (the Scheme) 'should be consistent with the internationally agreed climate change framework and cover only domestic emissions sources and sinks that are counted in Australia's Kyoto Protocol emissions inventory'.[12]

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10 The United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty setting out an overall framework for intergovernmental efforts to address climate change. Australia ratified the UNFCCC in December 1992. The Australian National Greenhouse Accounts is the accounting system developed to monitor and record changes in Australia's greenhouse gas emissions under the UNFCCC, see Department of Climate Change, *Australia's National Greenhouse Accounts*. Available at: http://www.climatechange.gov.au/inventory/index.html, accessed 29 October 2008. The National Greenhouse Gas Inventory estimates of Australia's greenhouse gas emissions are based on the accounting rules that apply to Australia's Kyoto Protocol emissions target of 108% of 1990 levels during the period 2008-2012.

11 *Committee Hansard*, 30 June 2008, p. 117.

12 Green Paper, p. 122.

4.13 Ms Blakers explained to the committee her concerns about proposals for an emissions trading scheme which did not include full carbon accounting.

> We are about to embark on a major economic change – namely, emissions trading. I do not know on which accounting system it will be based but, whichever accounting system it is, it is not going to be full carbon accounting. That leaves the potential for very major what people call 'perverse outcomes' because, if you are not counting everything properly – and, in particular, if you are not disaggregating it; looking at the emissions on the one side and the uptake on the other side – you do not know what you are dealing with. It is like a shop trying to work out what to sell and what stock to get in when all it knows is that it has had so many dollars worth of sales in the last six weeks but it does not know whether it sold oranges or barley sugar. It is the same problem with the carbon accounts. If you only have net figures, you do not know what you are dealing with – you do not know where the emissions are, you do not know where the uptake is and you cannot make policies to get rid of the emissions, which I would say is the primary objective, along with encouraging uptake where that is appropriate.[13]

4.14 Ms Blakers indicated to the committee that the UNFCCC system would be the best system to be used in an emissions trading scheme.[14]

The Kyoto Protocol accounting framework

4.15 The committee heard from a number of stakeholders concerned that the Kyoto Protocol framework would be adopted for accounting under the emissions trading scheme. This section of the report outlines how agricultural and forestry emissions are accounted for under the Kyoto Protocol accounting framework.

4.16 In determining its greenhouse gas emissions, a party to the Kyoto Protocol must account for emissions and removals from the following sectors: energy; industrial processes; solvent and other product use; agriculture; and waste.[15] As described in Chapter 3 of the report, agricultural emissions in this context include: enteric fermentation, manure management, rice cultivation, agricultural soils, prescribed burning of savannas, and field burning of agricultural residues.

4.17 In addition, under Article 3.3 of the Kyoto Protocol, a country must account for greenhouse gas emissions and removals in relation to direct, human-induced afforestation, deforestation and reforestation activities. Under Article 3.4 of the Kyoto Protocol, countries may also elect to include emissions and removals from the following activities: revegetation; forest land management; cropland management; and grazing land management.

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13 *Committee Hansard*, 30 June 2008, pp 117-118.

14 *Committee Hansard*, 30 June 2008, p. 122.

15 See Article 3.1 of the Kyoto Protocol and Annex A of the Kyoto Protocol.

4.18 In counting emissions towards its Kyoto Protocol target, Australia counts emissions from sources covered under Article 3.3 of the Kyoto Protocol, but has elected not to count sources covered under Article 3.4 of the Kyoto Protocol.[16] By implication, this means that farming practices covered by Article 3.4 of the Kyoto Protocol would not be included in the Scheme, were agriculture to be covered.

4.19 In responding to a question on notice, the Department of Climate Change stated that it has not conducted a regulatory impact assessment in relation to the inclusion of activities under Articles 3.3 and 3.4 of the Kyoto Protocol in Australia's emissions accounts. The Department of Climate Change went on to explain why the Australian Government elected not to include activities under Article 3.4 of the Kyoto Protocol in its emissions accounts:

> Australia has elected not to account for Article 3.4 activities for the first commitment period. This decision was based on a risk analysis prepared by the former Department of the Environment and Heritage (in consultation with other relevant departments), as well as consultations undertaken with state and territory governments and national agriculture and forest industry stakeholders. The risk analysis found that the accounting rules, Australia's variable climate, and the potential for disturbances such as bushfires introduce a high risk of significant negative emissions outcomes. The stakeholders endorsed the non-election of Article 3.4 activities.
>
> The treatment of Article 3.3 and 3.4 activities under post-2012 international climate change agreements will be considered in negotiations under the United Nations Framework Convention on Climate Change. The Australian Government is consulting stakeholders on this matter in developing its position for these negotiations, and will undertake further consultation as negotiations progress.[17]

4.20 In relation to coverage by the Scheme of afforestation, deforestation and reforestation activities, as defined in Article 3.3 of the Kyoto Protocol, the Government's preferred positions are as follows:

- all reforestation (as defined for the 2008-2012 period of the Kyoto Protocol) would be included in the Scheme, on a voluntary basis, from the commencement of the Scheme in 2010, with design details to be determined;[18]
- deforestation will not be included in the Scheme because Australian deforestation emissions have reduced markedly since 1990, due to increased protections against land clearing.[19]

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16 Department of Climate Change, *Australia's National Greenhouse Accounts: The Australian Government's Initial Report under the Kyoto Protocol*, 2008, p. 4.

17 Department of Climate Change, Answers to Questions on Notice, 25 August 2008.

18 Green Paper, p. 132.

19 Green Paper, p. 135.

4.21 The committee notes that deforestation activities are not included in the Scheme, despite being counted towards Australia's Kyoto Protocol targets.

Implications of an emissions trading scheme for agriculture

4.22 As was noted in the introduction, the details of the Scheme were not available at the time that the committee received submissions and held hearings in this Inquiry. Despite this, the committee received submissions and evidence on the implications of an emissions trading scheme for agriculture. One of the key issues raised was the possibility that an emissions trading scheme would not provide for full carbon accounting, particularly activities which are covered by Article 3.4 of the Kyoto Protocol.

4.23 Ms Nicolette Boele of the Agricultural Alliance on Climate Change (AACC) told the committee why she 'intuitively' supported a system of full carbon accounting if agriculture were included in an emissions trading scheme:

> …currently, under accounting protocols our commitments under the first Kyoto period are that we count the bad stuff. We count the methane emissions out the front end of the cows and we count the nitrous oxides that oxidise through urea et cetera and the relationship with the soils and other things like soil conditioners. We do not count the good stuff. We do not give farmers the opportunity to actually get paid to improve and better adapt to the changing climatic patterns. That, to me, is a complete opportunity lost.[20]

4.24 Mr Tim Wiley and Mr Bob Wilson provided the committee with a submission outlining why they supported full carbon accounting, particularly the inclusion of activities which increase soil carbon levels:

> Farm management methods can change the amount of carbon in the soil. A decrease in soil carbon is accounted for as an increase in a countries green house gas emission. While an increase in soil carbon levels is accounted as a reduction in emission for a country.
>
> … With full carbon accounting farmers could off set their emissions from live stock and energy use through the sequestration of carbon in vegetation and soil.[21]

4.25 Mr Wiley and Mr Wilson went on to note that the inclusion of Article 3.4 sinks in an emissions trading scheme could provide a much needed source of finance to farmers:

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20 Ms Nicolette Boele, *Committee Hansard*, 1 July 2008, pp 18-19.

21 *Submission 41*, pp 13 and 25. Soil carbon sequestration is discussed further in Chapter 3 of this report. See also: Mr Ben Fargher, Chief Executive Officer, National Farmers' Federation *Committee Hansard*, 1 July 2008, p. 27 and Mr Charles McElhone, Manager, Economics, National Farmers' Federation, *Committee Hansard*, 1 July 2008, p. 28.

> Carbon trading could provide the finance for agriculture restructure. If soil carbon (Kyoto Article 3.4 sinks) was recognised under the proposed national Emissions Trading Scheme (ETS) a new equity in agricultural land will be created. Farmers will then be able to borrow against their carbon sequestered or forward sell enough to finance the changes to their systems.[22]

4.26 The Australian Landcare Council noted that landholders could be paid for offsets provided, but also stated that such offsets are viewed with caution by rural industries because of the potential compliance constraints and liabilities involved, at least until national policy is more settled.[23]

4.27 The committee did receive evidence that expressed doubts as to the value of agricultural sequestrations under an emissions trading scheme. For example, the Queensland Government's submission stated:

> There is an expectation that there will be some financial benefit to farmers from the carbon they sequester in vegetation or in the soil, and carbon-trading schemes are currently being promoted to farmers. The value to farmers of carbon sequestration is highly speculative until the design of the trading scheme is resolved, and a means of verifying sequestration is determined.[24]

4.28 The Future Farm Industries Cooperative Research Centre (Future Farm Industries CRC) described as 'hype' the proposition that farmers will be able to sequester carbon in plants and soils and sell it through emissions trading:

> Experience with the NSW Greenhouse Gas Abatement Scheme has already shown that individual farmers and incremental improvements in soil carbon will not be in the market.
>
> These schemes are for larger players who can validate to a fussy buyer or regulator the amount of carbon sequestered, underwrite its security for 70-100 years, and manage the risk of depletion events such as fire and erosion.[25]

4.29 Ms Boele cited the trading of soil carbon on the Chicago Climate Exchange as one example of where soil carbon trading had been successfully incorporated into an emissions trading scheme.[26] Ms Boele also explained to the committee how the

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22 *Submission 41*, p. 30.

23 *Submission 13*, p. 4.

24 *Submission 30*, p. 7. See also: Victorian Department of Primary Industries, *Submission 27*, p. 18; and Dr Beverly Henry, Manager, Environment, Sustainability and Climate Change, Meat & Livestock Australia, *Committee Hansard*, 1 July 2008, p. 14.

25 Future Farm Industries Cooperative Research Centre, *Submission 38*, attachment: Mr Kevin Goss, Chief Executive Officer, Future Farm Industries, Cooperative Research Centre, *Address to the Rural Press Club of Victoria*, 28 February 2008, p. 3.

26 *Committee Hansard*, 1 July 2008, p. 19.

Chicago Climate Exchange had found a way around the 'imperfect science of soil carbon':

> They divide the continent of North America into two rainfall zones. Essentially, there is desert, which they give a 0.4 value to, and then there are regular rainfall areas, which get a value of one. Then there are approximately seven or eight different soil types … They have done the tests on the ground about changing practice A to practice B with a fence line in the middle, and done the science on approximately how much extra carbon they get in the soil. Then they have just done these proxies…where they have just said that a certain strand of eucalyptus planted in this geographical region is going to have a proxy value of X. It is the same thing they have done in the United States: if you change your management from A to B, you get a credit of whatever it might be. That credit then becomes, at the end, a function of which rainfall pattern you are in – high or low – and then which soil type as well. Then they discount it even further to provide enough market confidence. Of course, some farmers decide not to do it because they are sequestering a lot more carbon than the credit they get for it.[27]

4.30 The committee also notes Ms Boele's statements about the role of governments in providing confidence to achieve these ends:

> What we found was that yes, there are still barriers to understanding the science … but equally what is missing is market confidence that there will in fact be a market for soil carbon. I am not getting any signals yet from the Commonwealth or from the elected officials that soil carbon can be part of Australia's international response on climate change. Without that statement – and hopefully we will get it in the Green Paper this month – it is little wonder that [Meat and Livestock Australia] is not investing extra money in it and that the private sector, like Macquarie Bank, has not leapt on doing deals with farmers for soil carbon improvements.
>
> Without that certainty you will not get farmers paid to improve the land. We do not actually have to have huge amounts in the government coffers to do it. The private sector can probably do quite a bit of that.[28]

4.31 The need for political guidance on this issue was emphasised to the committee on its visit to the Binnu district of Western Australia. Mr Wiley and Mr Wilson noted in their submission that mining companies in Western Australia are interested in funding research into farming systems that sequester carbon. However, as Mr Wilson pointed out when the committee visited Binnu following the release of the Green Paper, in the event that soil carbon sequestration was not covered in the emissions trading scheme, there were would be little motivation for mining companies to invest in this type of research.

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27 *Committee Hansard*, 1 July 2008, p. 20.

28 *Committee Hansard*, 1 July 2008, p. 16.

Implications of an emissions trading scheme for the forestry sector

4.32 Submissions and evidence to the inquiry from the forest industry demonstrated that it supports the forestry and plantation industry playing an important role in an emissions trading scheme. However, the committee also heard concerns from those in the agricultural industry about the potential impacts of including forestry sinks, albeit voluntarily, in an emissions trading scheme. The role that the forestry industry can play in adapting to, and mitigating, climate change is discussed in Chapter 3.

4.33 AP3, the peak representative body for the Australian plantation, plantation products and paper industry, outlined some of the reasons it believed that reforestation was amenable to inclusion in an emissions trading scheme:

> …the reasons for possible exclusion of the agriculture or forestry sectors include difficulties in measurement and the relative cost of measurement compared to the likely abatement or emissions.
>
> … The major source of abatement in the forestry sector will be from the establishment of trees on previously cleared land (reforestation). This is a relatively small subset of the measurement challenge posed by the combined agriculture and forestry sectors. These areas are readily identifiable and measurable. The emissions and storage of carbon from these plantations can be successfully tracked and accounted.[29]

4.34 In its submission to the Garnaut Climate Change Review, the National Association of Forest Industries outlined the potential for carbon sequestration offered by the expansion of plantation forests covered in Australia's Kyoto Protocol targets.[30] However, the Green Institute described offsetting emissions by replanting as 'slow and inefficient' and argued that tree planting should only be allowed to create offsets under an emissions trading scheme in very limited circumstances.[31]

4.35 Another aspect of an emissions trading scheme that the committee was interested in was whether there is a point at which plantations become more valuable as a carbon sink, than for timber products. Ms Blakers outlined for the committee the type of situation where there may be plantations that become too expensive to cut down:

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29 *Submission 9*, p. 5.

30 National Association of Forestry Industries and Tree Plantations Australia, *Garnaut Climate Change Review: Issues paper 1 – Climate Change: Land use – Agriculture and Forestry. A response by the national Association of Forest Industries and Tree Plantations Australia*, December 2007. Available at: http://www.garnautreview.org.au/CA25734E0016A131/WebObj/35549ResponsetoIssuePaper1-NAFIandTPASubmission-V2/$File/35549%20Response%20to%20Issue%20Paper%201%20-%20%20NAFI%20and%20TPA%20Submission%20-%20V2.pdf, accessed 22 November 2008, p. 4.

31 Green Institute, *Supplementary submission*, tabled 30 June 2008.

> So the question of having wood as a joint product with carbon is a really critical one. If you end up with a plantation and the current rules for permanence say 70 years – that is, under the government's greenhouse-friendly rules—if you are committed to holding your plantation or your pool of plantations for 70 years, then the price of carbon will have gone up enormously but the price of wood very likely will not have, and so you might very well end up with plantations that you can never afford to cut down because the carbon emissions cost will be too great.[32]

4.36 Mr Hansard indicated that NAFI had not done any modelling on this point.[33]

4.37 The committee also heard concerns about the environmental impacts that may result if an emissions trading scheme was to result in an increase in forestry at the expense of agricultural industries. Mr Charles McElhorne of the NFF, outlined concerns that the NFF have about the balance between forestry and agriculture in an emissions trading scheme:

> I have been particularly focused on the perverse outcome potential in the economic field, but there is also potential for perverse outcomes in the environmental area. What are the water run-off and biodiversity issues of replacing agricultural land with mass plantation forestry in order to meet our Kyoto [Protocol] obligations? And what are the social implications of [an emissions trading scheme] as well? We have to get those policy settings right.[34]

4.38 The Victorian Department of Primary Industries also noted the conflict an emissions trading scheme could create as there was a shortage of suitable land in that State for commercial carbon sinks:

> Victoria's prime areas for plantation forestry are those with a higher than average rainfall (over 600mm) and fertile, well drained soils, which are also prime agricultural land.[35]

4.39 Professor Michael Young of the Wentworth Group of Concerned Scientists expressed concern that the inclusion of forestry in an emissions trading scheme would have impacts on water availability:

> …another very important thing that Australia is still finding it greatly difficult to face up to. That is the issue of the interception of rainfall by forests – particularly in plantation forests. Your discussions and the evidence you have received have talked about the plans to set up an emissions-trading system from 2010. It will give people credits for planting forests. Forests tend to get planted in high rainfall areas and areas where

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32 *Committee Hansard*, 30 June 2008, pp 122-123.

33 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Committee Hansard*, 30 June 2008, p. 115.

34 *Committee Hansard*, 1 July 2008, p. 28.

35 *Submission 27*, p. 19. See also: Ms Blakers, *Committee Hansard*, 30 June 2008, p. 118.

> roots can access water free of charge. It is high security water; it is the water that is taken first. When you plant a tree, it intercepts all the water it needs before it lets any run off. If you plant a tree close to a river and it gets its roots into the river or into the aquifer, it takes all the water it needs. It grows on hydroponics. If Australia goes into an emissions-trading system that gives people carbon credits for planting trees and does not bring water accounting into that regime then this nation could be in very serious strife as we dry up our rivers.[36]

4.40 While acknowledging that trees grow better in high rainfall areas, representatives from NAFI argued that the forest industry's strategy was to plant trees in areas that benefited downstream agricultural industries:

> …the strategy for the forest industry going forward is based on being smart about where we put trees in the landscape so we can reduce salinity … because this really will help agriculture. As we know, we cannot grow food crops with saline water. However, if we are smart about where we put trees in the landscape we can actually decrease salinity … and actually increase our ability to grow food.[37]

Committee view

4.41 The committee understands the difficulties in including the agricultural sector in an emissions trading scheme from its proposed commencement date in 2010. The committee encourages the Government to put substantial resources into investigating and resolving the difficulties before considering including agriculture in the Scheme.

4.42 The committee recognises that forests play an important role in the mitigation of greenhouse gas emissions. However, the committee is equally concerned that as currently structured, there is the possibility the Scheme will not maintain the important balance between the forestry and agricultural sectors, resulting in adverse social and environmental consequences. The committee believes that introducing full carbon accounting as the framework for an emissions trading scheme would go some way to redressing this imbalance. The committee notes that this recommendation is in line with the proposed approach of the Garnaut Review on Climate Change.[38]

Recommendation 2

4.43 The committee recommends that the Government should provide for a full carbon accounting framework in relation to agricultural and forestry sectors in a domestic emissions trading scheme.

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36 *Committee Hansard*, 1 July 2008, p. 40.

37 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Committee Hansard*, 30 June 2008, p. 105.

38 Professor Ross Garnaut, *Garnaut Review on Climate Change*, September 2008, p. 536.

Chapter 5

A national climate change strategy to assist the Australian agricultural sector adapt to climate change

Introduction

5.1 The committee received many submissions in support of a coordinated national strategy to assist the Australian agricultural industry to adapt to climate change. For example, the Primary Industries and Natural Resources Curriculum Centre said such a strategy is 'critical'.[1]

5.2 The Bureau of Meteorology emphasised the need for the development of regional strategies along side a national strategy:

> It is clear that climate change will have an Australia-wide impact, and hence this requires both national and regional strategies for long and short term adaptation. Such strategies must prioritise the basic underlying data, information and associated tools, which can most effectively be developed and/or maintained at a national level but may also be applied on a national or regional basis.[2]

5.3 Some submissions emphasised the need for national strategies in relation to particular aspects of adaptation by the agricultural sector. For example, the Primary Industries and Natural Resources Curriculum Centre, TAFE, NSW outlined a broad range of educational initiatives that should be incorporated into a national strategy. These include expansion of the Australian Sustainable Schools Initiative, development of specific education programs to assist primary producers to cope with climate change, and promotion of women's networks like the Tarcutta 'Desperate Farm Wives' to support educational initiatives.[3]

5.4 This chapter starts with an outline of the current strategies and future initiatives to help the Australian agricultural sector to adapt to climate change. The

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1 *Submission* 4, p. 1. See also: Cooperative Research Centre for National Plant Biosecurity, *Submission 16*, p. 3 and Wentworth Group of Concerned Scientists, *Submission 17*, cover letter.

2 *Submission* 7, pp 6-7. See also: Rural Business Development Corporation, *Submission 15*, p. 2.

3 *Submission 4*, pp 2-3. Information on the Australian Sustainable Schools Initiative is available from the Department of Environment, Water, Heritage and the Arts website: http://www.environment.gov.au/education/aussi/about.html, accessed 23 November 2008. The Tarcutta Desperate Farm Wives was formed in December 2006 and organises local events to encourage social interaction in the area of Tarcutta which has been severely affected by drought. See also: Land & Water Australia, *Submission 3*, p. 3, on the need for a coordinated national research strategy, and Council of Australian Weed Societies Inc., *Submission 5*, p. 2, on the need for a strategic approach to managing weeds at a national, regional and local level.

discussion then details some of the suggestions in submissions and evidence about what needs to be included in a national strategy.

Current initiatives

5.5 The joint submission of Department of Agriculture, Fisheries and Forestry (DAFF) and the Department of Climate Change (DCC) states that 'there would appear to be a strong case for developing a comprehensive long-term climate change strategy for agriculture'.[4]

5.6 The DAFF/DCC submission went on to detail the outcomes of the Primary Industry Ministerial Forum, in February 2008, where:

> …Ministers made a commitment to progress work on emissions management and adaptation and to coordinate research and development activity across jurisdictions. The need to understand and take into account the likely social impacts of climate change on rural and regional Australia was also acknowledged.[5]

5.7 The DAFF/DCC submission noted that DAFF, in conjunction with DCC, will develop a national climate change strategy for agriculture. This will be done in consultation with the agriculture sector, other Commonwealth agencies and the states and territories to bringing about a coordinated and comprehensive approach to helping the sector prepare for the challenges of climate change.[6]

5.8 The DAFF/DCC submission then when to on outline what it describes as the 'guiding principles for a national strategy':

1. improved quality of information;
2. management of greenhouse gas emissions;
3. adapting to the impacts of climate change; and
4. coordination of activity and dissemination of information.[7]

5.9 The next section of the report outlines the current initiatives that DAFF/DCC identified as being part of a national strategy to assist the Australian agricultural sector to adapt to climate change.

Australian Climate Change Science Program

5.10 The Australian Climate Change Science Program is administered by DCC. It aims to:

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4 *Submission* 34, p. 10.

5 *Submission* 34, p. 10.

6 *Submission* 34, pp 10-11.

7 *Submission* 34, p. 12.

> …improve our understanding of the causes, nature, timing and consequences of climate change so that industry, community and government decisions can be better informed.[8]

5.11 The Australian Climate Change Science Program addresses six key themes: understanding the key drivers for climate change in Australia; improved climate modelling systems; climate change, climate variability and extreme events; regional climate change projections; international research collaboration; and communications.

5.12 The program is conducted in partnership with leading scientific agencies, most notably CSIRO and the Bureau of Meteorology.[9]

Greenhouse Action in Regional Australia

5.13 The Greenhouse Action in Regional Australia (GARA) program was established in 2004, and the DCC is the lead agency. The GARA program has facilitated strategic climate research to build the capacity of the agriculture and land management sectors to manage greenhouse gas emissions and respond to climate change. Research areas include livestock and emissions from soils, emissions from savannas and forests, and climate change responses in farming systems and natural resource management.[10]

Managing Climate Variability Program

5.14 The Managing Climate Variability Program (MCVP) program aims to enhance adaptation responses to a variable climate:

> The program's top priority is to provide more accurate and reliable climate information forecasts and tools to enable farmers and natural resource managers to reduce their exposure to risk from climate change.[11]

5.15 According to the DAFF/DCC submission the Australian Climate Change Science Program, GARA and MCVP will provide a 'solid foundation' in addressing the first key principle of the climate change strategy for agriculture – improved quality of information. The work of these programs will also provide valuable inputs to address the third key principle of a national strategy – adapting to the impacts of climate change.[12]

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8 *Submission* 34, p. 13.

9 *Submission* 34, p. 13.

10 *Submission* 34, p. 13. See also: Chapter 3, 'Mitigating agricultural emissions'.

11 *Submission* 34, pp 13-14. See also: Chapter 3, 'Adapting to climate change'.

12 *Submission* 34, pp 12-13.

National Climate Change Adaptation Framework

5.16 The National Climate Change Adaptation Framework (the Framework) includes actions across all jurisdictions to assist sectors that are vulnerable to climate change including agriculture, biodiversity, forestry, coastal and water resources. The Framework was endorsed by the Council of Australian Governments (COAG) in April 2007. In December 2007, COAG agreed to accelerate the implementation of the Framework.[13]

5.17 The Framework will guide action by jurisdictions over the next five to seven years to:

- support decision-makers with practical guides and tools to assist in managing climate change impacts;
- establish a new centre for climate change adaptation to provide decision-makers with robust and relevant information on climate change impacts, vulnerability and adaptation options;
- provide, for the first time, climate change projections and regional scenarios at scales relevant to decision-makers;
- generate the knowledge to understand and manage climate change risks to water resources, biodiversity, coasts, agriculture, fisheries, forestry, human health, tourism, settlements and infrastructure;
- work with stakeholders in key sectors to commence developing practical strategies to manage the risks of climate change impacts; and
- assess the implications of climate change and possible adaptations for important regions such as the Murray-Darling Basin, south-west Western Australia, the tropical north, and the drying regions of eastern Australia.[14]

5.18 The DAFF/DCC submission states that the Australian Government has committed $170 million to the implementation of the Framework. That commitment includes the establishment of a Climate Change Adaptation Research Facility at Griffith University and the establishment of a new CSIRO Flagship on Climate Change Adaptation.[15] Representatives of the DCC provided the committee with information on the progress of the Climate Change Adaptation Research Facility at Griffith University.[16]

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13 *Submission 34*, p. 8.

14 National Climate Change Adaptation Framework, p. 3. Available at: http://www.coag.gov.au/coag_meeting_outcomes/2007-04-13/docs/national_climate_change_adaption_framework.pdf, accessed 16 November 2008.

15 *Submission 34*, p. 8.

16 Mr Ian Carruthers, First Assistant Secretary, Adaptation and Land Management Division, Department of Climate Change, *Committee Hansard* , 1 July 2008, pp 77-78.

National Agriculture and Climate Change Action Plan 2006-2009

5.19 Most of the information provided to the committee in relation to the progress of the Framework related to the National Agriculture and Climate Change Action Plan (NACCAP) 2006-2009. NACCAP was endorsed by the Natural Resource Management Ministerial Council in April 2006 and by COAG in March 2007. NACCAP is an agreement of Australian Governments to:

> …develop a coordinated framework for climate change policy in agriculture to contribute to the development of a sustainable, competitive and profitable Australian agricultural sector into the future. It will provide Australian, state and territory governments and research and development (R&D) organisations with a practical tool to develop effective and efficient policies to overcome the challenges imposed by climate change.[17]

5.20 NACCAP identifies four key areas to manage the multiple risks to sustainable agriculture during a period of changing climate:

- adaptation strategies to build resilience into agricultural systems;
- mitigation strategies to reduce greenhouse gas emissions;
- research and development to enhance the agricultural sector's capacity to respond to climate change; and
- awareness and communication to inform decision-making by primary producers and rural communities.[18]

5.21 The DAFF/DCC submission states that during 2007-08 the Australian Government awarded $5 million to implement 19 projects funded under NACCAP:

> All projects funded involve a close partnership with landholders, industry organisations and research providers and focus on areas where climate change management is a priority issue for farmers.[19]

5.22 One example of a project funded under the NACCAP is the *Methane to Markets* program, which aims to lower agricultural emissions by capturing and using methane for energy generation. NACCAP also funds projects to commence development of Climate Change Action Plans for the forestry and fisheries sector.[20]

5.23 In relation to the progress of the NACCAP, the DAFF/DCC submission states that a current review of NACCAP has identified 142 actions underway or completed

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17 National Agriculture and Climate Change Action Plan 2006-2009, p. 1. Available at: http://www.daff.gov.au/__data/assets/pdf_file/0006/33981/nat_ag_clim_chang_action_plan2006.pdf; accessed 16 November 2008.

18 National Agriculture and Climate Change Action Plan 2006-2009, p. 1.

19 *Submission 34*, p. 15.

20 *Submission 34*, p. 15. See also: Chapter 3, 'Other forms of alternative energy generation'.

across jurisdictions, with the main emphasis on adaptation. The submission goes on to note:

> While there has been a large number of actions undertaken consistent with NACCAP, there is evidence of a need for better coordination of actions across jurisdictions, and a need for a more strategic effort for targeting research efforts and improved communication.[21]

5.24 The DAFF/DCC submission also notes that the Australian Government recently committed to fast tracking the implementation of NACCAP to help Australian agriculture better manage climate change.[22]

National Climate Change Research Strategy for Primary Industries

5.25 The National Climate Change Research Strategy for Primary Industries (CCRSPI) is a joint initiative of the Rural Research and Development Corporations, federal, state and territory governments, and the CSIRO. CCRSPI is managed by Land & Water Australia.

5.26 Dr Michael Robinson, Executive Director of Land & Water Australia, and Chair of the Joint Strategy Team for CCRSPI, explained to the committee the aims of the project:

> The initiative looked at what exactly were the national and collaborative research needs of primary industries, including development and adoption – this is not just about the pure research end – including both the direct and indirect impact of climate change; that is also the biophysical, social and economic. We also undertook to look at mapping existing and developing research activity in this space, to look at the short- and longer term research priorities and to see where the collaborative coordination opportunities exist around Australia for this existing and new research. We then wanted to develop implementation options for making this happen in order to have a truly national coordinated and collaborative research effort in response to climate change.[23]

5.27 CCRSPI's initial report has identified six priority research areas for collaborative research, development and extension across industry and government:

- understanding future climates – need for better information about future climate and climate variability at seasonal timescales;
- managing emissions – need for an understanding of primary production life-cycles and processes to reduce and offset emissions;
- preparing industries – adaptation – need to adapt and respond to climate change to maintain productive, profitable and sustainable systems;

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21 *Submission 34*, p. 9.

22 *Submission 34*, p. 8.

23 *Committee Hansard*, 30 June 2008, p. 58.

- accessing information – need for access to clear, relevant and factual information that is nationally consistent, but regionally and sectorally specific;
- facilitating change – through capacity and capability development; and
- linking decision makers – encouraging dialogue between researchers, policy makers and primary producers to align research priorities, policy development and industry responses.

5.28 The initial CCRSPI report also outlines existing research activity and major gaps in knowledge.[24]

5.29 The DAFF/DCC submission states that CCRSPI will 'provide guidance on setting climate change research priorities for agriculture under Australia's Farming Future … and the COAG National Climate Change Adaptation Framework'.[25]

5.30 The committee notes the evidence of Mr Kevin Goss of the Future Farm Industries Cooperative Research Centre in relation to the challenges that face CCRSPI:

> There are some risks to it, and the risks are non-engagement by some parties. I should also say that, right now, CCRSPI requires very strong leadership from the Commonwealth agencies and also a strong coordinated leadership by them – that is, coming together and providing that leadership.[26]

5.31 Despite these concerns, Mr Goss also stated that 'it is the best thing going' and he believes that it is the foundation for an ongoing research and development strategy.[27]

Centre for Australian Weather and Climate Research

5.32 The Bureau of Meteorology (BoM) and CSIRO are jointly developing world class climate models and related technologies through the Centre for Australian Weather and Climate Research.[28]

5.33 The DAFF/DCC submission gave the following summary of the work of the Centre:

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24 Land & Water Australia, *A National Climate Change Research Strategy for Primary Industries: Phase 1 Report*, July 2008. Available at: http://sites.lwa.gov.au/ccrspi/, accessed 23 November 2008.

25 *Submission 34*, p. 14.

26 Mr Kevin Goss, Chief Executive Officer, Future Farm Industries CRC, *Committee Hansard*, 30 June 2008, p. 85.

27 *Committee Hansard*, 30 June 2008, p. 85.

28 Bureau of Meteorology, *Submission 7*, p. 2

> The Centre will provide seasonal weather/climate forecasts, support impact and adaptation research, enhance prediction of extreme weather/climate events and provide superior research capability for determining accurate water budgets for different systems (taking into account temperature, precipitation, soil moisture, runoff, evaporation and streamflows).[29]

5.34 The committee also received evidence about other joint CSIRO and BoM projects, such as the Australian Community Climate and Earth Systems Simulator (ACCESS) which is being developed to improve capacity to study and project climate in our region. The committee also notes that BoM has developed a suite of tools designed to provide climate information and assist farmers to manage climate risk.[30]

Other initiatives

5.35 The DAFF/DCC submission also notes some initiatives which have resulted from cooperative efforts between jurisdictions:

- the commissioning by the Natural Resource Management Ministerial Council of an assessment of the vulnerability to climate change of Australian agriculture and regions dependent on agriculture, which is due to be completed in 2008; and
- a cross-jurisdictional Emission Intensity Benchmarking Working group, established by the Natural Resource Management Ministerial Council. Emissions intensity benchmarking is a systematic approach to enable landholders to understand the effects of different management practices on greenhouse gas emissions, and to provide guidance on implementing improved practice leading to reduced emissions intensity. This Working group will 'explore the next steps in implementation of emissions intensity benchmarking'.[31]

5.36 The DAFF/DCC submission also noted two tools, the National Carbon Accounting System (NCAS) and the National Carbon Accounting Toolbox (NCAT), which have been developed to assist with the carbon accounting in relation to land use:

> Ongoing development of NCAS and NCAT is focused on improving the capabilities of the system to account for non-carbon dioxide emissions such as methane and nitrous oxide from land-based activities. NCAT is also being further developed to improve its usability and provide low-cost project level greenhouse gas accounts.[32]

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29 *Submission 34*, p. 15

30 Bureau of Meteorology, *Submission 7*, pp 5-6.

31 *Submission 34*, p. 14.

32 *Submission 34*, p. 11.

Awareness of current initiatives

5.37 The committee was interested to find out how much was known about all the current initiatives outlined above by those in the agricultural sector, and more generally in the community.

5.38 CCRSPI was the most widely recognised of the initiatives, with a number of submitters and witnesses supportive of, and in some cases participating in, the process.[33]

5.39 Aside from CCRSPI, there appeared to be very little awareness by those in the agricultural sector of the initiatives that the DAFF/DCC submission described, although there is recognition within governments and scientific organisations of many of the initiatives. For example, the Bureau of Meteorology submission referred to the establishment of the Centre for Australian Weather and Climate Research, and noted that this facility needed to be supported by DCC through the Australian Climate Change Science Program and the National Climate Change Adaptation Framework.[34] Land & Water Australia referred to its involvement in the Managing Climate Variability Program.[35] The Queensland Government stated that it is in the process of implementing its ClimateSmart Adaptation Plan (2007–12), which specifically includes primary industries and supports the National Agriculture and Climate Change Action Plan 2006–2009.[36]

Future initiatives

5.40 The DAFF/DCC submission also referred to three future initiatives for addressing the gaps in the strategy, namely: Australia's Farming Future; the COAG Working Group on Climate Change and Water; and the potential future reform of drought policy. The potential future reform of drought policy was discussed in the committee's Interim Report.[37]

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33 See for example Mr Greg Brown, Acting President of the Cattle Council of Australia, *Committee Hansard*, 1 July 2008, p. 3; Dr Beverly Henry, Manager Environment, Sustainability and Climate Change, Meat and Livestock Australia, *Committee Hansard*, 1 July 2008, p. 4; Ms Nicolette Boele, Director, Strategic Projects, Agricultural Alliance on Climate Change, *Committee Hansard*, 1 July 2008, p. 18; Mr Ben Fargher, Chief Executive Officer, National Farmers' Federation, *Committee Hansard*, 1 July 2008, p. 30.

34 *Submission 7*, p. 2.

35 *Submission 3*, p. 2.

36 *Submission 30*, p. 2.

37 Senate Rural and Regional Affairs and Transport Committee, *Climate change and the Australian agricultural sector: Interim Report* (Interim Report), September 2008, pp 21-22.

Australia's Farming Future

5.41 Australia's Farming Future builds on the Australian Government's commitment to fast-track the NACCAP. According to the DAFF/ DCC submission, the Government has provided $130 million over four years to fund three distinct but connected programs: the Climate Change and Productivity Research Program ($15 million); the Climate Change Adaptation Partnership Program ($60 million); and the Climate Change Adjustment Program ($55 million).[38]

5.42 The committee notes, however, that more recent information on the DAFF website describes the programs in a slightly different manner, and with very different funding allocations:

- The Climate Change Research Program ($46.2 million) to fund research projects and on-farm demonstration pilots that address the following priorities: reducing greenhouse pollution; better soil management; and adapting to a changing climate.[39]
- FarmReady ($26.5 million) to boost training opportunities for primary producers, and to enable industry, farming groups and natural resource management groups to develop strategies to adapt and respond to the impacts of climate change. Two grants will be available through the FarmReady program: the primary producer reimbursement grant; and the industry grant.[40]
- The Climate Change Adjustment Program provides assistance for primary producers to manage the impacts of climate change, including targeted training activities; individually tailored adjustment advice; and assistance while farmers consider their future in farming.[41]

5.43 It is not clear from the DAFF website why these changes have been made to the Australia's Farming Future initiative.

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38 *Submission 34*, p. 16. See also Mr Mark Gibbs, General Manager, Climate Change Policy, Department of Agriculture, Fisheries and Forestry, *Committee Hansard*, 1 July 2008, p. 77.

39 DAFF website, *Climate Change Research Program*, updated 9 September 2008. Available at: http://www.daff.gov.au/climatechange/australias-farming-future/climate-change-and-productivity-research, accessed 16 November 2008.

40 DAFF website, *FarmReady*, updated 30 October 2008. Available at: http://www.daff.gov.au/climatechange/australias-farming-future/farmready, accessed 16 November 2008.

41 DAFF website, *Climate Change Adjustment*, updated 6 November 2008. Available at: http://www.daff.gov.au/climatechange/australias-farming-future/climate-change-adjustment-assistance, accessed 16 November 2008. No funding allocation for this initiative was outlined on the website. The Climate Change Adjustment Program is discussed in the committee's Interim Report, pp 20-21.

COAG Working Group on Climate Change and Water

5.44 The COAG Working Group on Climate Change and Water was established in December 2007, and 'will provide a mechanism to progress cross-jurisdictional coordination on climate change action'.[42]

5.45 The committee received very little information on this initiative, other than ascertaining that in December 2007, COAG agreed that part of the indicative forward work program from March 2008 of the Climate Change and Water Working group would include accelerating the implementation of actions under the National Climate Change Adaptation Framework.[43]

What should be included in a national strategy?

5.46 The committee received an overwhelming response in submissions to the question of specific initiatives which should be included in a national strategy to assist the Australian agricultural sector to adapt to climate change. This section of the report outlines some of the key examples of broadly applicable initiatives provided to the committee of what should be included in a national strategy.

Water policy

5.47 The development of a cohesive national water strategy is an area that received attention from many submissions and will impact across the agricultural sector. The National Water Initiative (NWI) was a focus in this area of discussion. The Wentworth Group of Concerned Scientists described the NWI as a 'uniquely clear statement of international best practice in water management', but went on to highlight:

> When the NWI was negotiated, it was decided that it was no longer necessary to make delivery of agreed milestones a necessary condition for states to receive competition payments.
>
> Unfortunately, without the financial discipline imposed by competition payments on state and territory governments, water reform progress has slowed to a snail like pace and, to make matters worse, many of the old *ad hoc* water policy and administration habits have started to return.[44]

5.48 Growcom called for a review of national and state water management:

> A particular issue that requires attention is that of how to continue water reforms spelt out in the National Water Initiative process while providing scope for growers to diversify their farm water sources, water harvesting opportunities or management options. Tightening regulation of water

42 *Submission 34*, p. 16.

43 *Submission 34*, p. 8.

44 *Submission 17*, attachment: Prof. Mike Young and Jim McColl, *A future-proofed basin: A new water management regime for the Murray-Darling Basin*, 2008, pp 1-2.

> resource allocation and management currently severely limit [sic] the capacity and flexibility of growers to adapt to changing rainfall patterns (eg there are legal constraints to increasing on-farm water harvesting or storage).[45]

5.49 The NSW Irrigators' Council noted the NWI has allocated significant funding to scientific studies of catchments and likely future yields. The NSW Irrigators' Council stated the need for 'good scientific, social and economic data upon which to base long term policy' and argued that the current system of Available Water Determinations and Water Sharing Plans should not be altered until that data is available.[46]

5.50 The National Association of Forestry Industries also noted in its submission that it is particularly concerned that water policy development under the NWI may unfairly restrict plantation establishment.[47]

5.51 A number of submissions and evidence to the committee highlighted the potential for adaptation strategies or policies to be maladaptive or result in perverse outcomes.[48] One good example of this was discussed in the submission of The Australia Institute in relation to water policy, in particular how compensation schemes can influence behaviour in relation to water use:

> The payment of compensation to farmers for regulatory restrictions on their property rights can reduce the incentive for them to adopt sustainable natural resource management practices. Take the case of a farmer who recognises their irrigation practices are damaging the environment, primarily because they are extracting too much water from the local river at a time of year when the ecosystem needs higher flows. Why would the farmer voluntarily reduce their water use if they can get paid by the government to do so? There is a disincentive to reduce diversions voluntarily, 'because their adoption … would result in a reduction in subsidy payments to them in the future'. The creation of additional rights to compensation can also reinforce perceptions that property owners have a right to manage 'their' resources in an unsustainable manner.[49]

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45 *Submission 31*, pp 12-13.

46 *Submission 18*, p. 4. See also Gwydir Valley Irrigators Association Inc, *Submission 14*, p. 4.

47 *Submission 6*, p. 4.

48 See for example Dr Mark Howden, CSIRO, *Committee Hansard*, 30 June 2008, p. 10; Dr Michael Robinson, Executive Director, and Chair, Joint Strategy Team, National Climate Change Research Strategy for Primary Industries, Land & Water Australia, *Committee Hansard*, 30 June 2008, pp 64-65; Ms Margaret Blakers, Green Institute, *Committee Hansard*, 30 June 2008, pp 117-118; Mr Ben Fargher, Chief Executive Officer, National Farmers' Federation, *Committee Hansard*, 1 July 2008, pp 27-28 and Australian Landcare Council, *Submission 13*, p. 4.

49 The Australia Institute, *Submission 21*, attachment: Andrew Macintosh and Richard Denniss, *Property Rights and the Environment: Should farmers have a right to compensation?* Discussion Paper No. 74, November 2004, p. 37 (references not included).

The development of a database of natural resource information

5.52 The National Land and Water Resources Audit Advisory Council (Audit Advisory Council) made a compelling submission for collection, management and availability across jurisdictions of national resource information. The Audit Advisory Council drew attention to the assessment reports released by the National Land and Water Resources Audit, and specifically the Australian Agricultural Assessment:

> …this work identifies the cost of specific forms of land degradation to Australian agriculture and has provided basic information pertaining to the natural resources on which Agriculture depends. Clearly we will need to know the description of the soils and vegetation resources, and the capacity of our land managers to change land use and management practices to be able to model changing land use as a result of predicted changes in climate.[50]

5.53 One of the key points of the Audit Advisory Council's submission was the need for coordinated collection and management of national resource information:

> Despite the previous activity of the [National Land and Water Resources Audit], and progressive State of Environment reporting, there is still no definitive overall view of the types of natural resource information that are required to be collected in the national interest, and managed as a national asset.[51]

Development and management of biosecurity policy

5.54 Another area of a national strategy that could have broad application across the agricultural sector is the development and management of biosecurity policy. As was outlined in Chapter 2 climate change will impact on the distribution of pests, weeds and diseases, as well as giving rise to the potential for the introduction of new pests, weeds and diseases to Australia.

5.55 The CSIRO submission provides some guidance as to what might be required to improve biosecurity in the face of climate change:

> Maintain or improve quarantine capabilities, sentinel monitoring programs and commitment to identification and management of pests, diseases and weed threats. Improve the effectiveness of pest, disease and weed management practices through predictive tools such as quantitative models, integrated pest management, area-wide pest management, routine record keeping of climate and pest/disease/weed threat, and through development of resistant species and improved management practices.[52]

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50 *Submission* 33, cover letter.

51 *Submission* 33, p. 3.

52 CSIRO, *Submission 32*, p. 22. See also: Council of Australasian Weed Societies Inc., *Submission 5*; Cooperative Research Centre for National Plant Biosecurity, *Submission 16* and Cooperative Research Centre for Australian Weed Management, *Submission 19*, p. 3.

Compliance with international obligations

5.56 The University of Sydney Faculty of Law stated in its submission that '[i]n responding to climate change through laws and policies … it is important that Australia is mindful of the obligations it has assumed (and is likely in the future to assume) under international law'.[53]

5.57 Those obligations include commitments under the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol:

> The UNFCCC imposes on states a responsibility to adapt their practices to insulate important sectors against the effects of climate change. It requires States to 'develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture'. Social, economic and environmental policies should be formulated 'with a view to minimizing adverse effects on the economy'. Similarly, the [Kyoto Protocol] encourages States to develop and promote sustainable forms of agriculture.[54]

Other initiatives

5.58 The committee also notes the work that is going on at a regional and industry level to assist the agricultural sector to adapt to climate change. Some initiatives that the committee heard about included:

- the Winemakers Federation, which has been working with international wine industry bodies to develop a Greenhouse Gas Accounting Protocol for the International Wine Industry and calculator tool; and[55]
- the work of the Cooperative Research Centre for National Plant Biosecurity which has initiated a research project called 'Understanding and responding to the risks associated with climate change and plant biosecurity' in partnership with the Pratique bid (a consortium of 13 European research organisations). The project will examine the potential risks using pests and diseases identified in partnership with industry.[56]

Committee view

5.59 The committee is concerned that information on work being done to develop a national strategy to assist the Australian agricultural sector to adapt to climate change appears not to be reaching those who need it most – those in the agricultural sector.

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53 *Submission 39*, p. 2.

54 *Submission 39*, p. 4 (references not included).

55 *Submission 22*, p. 1.

56 *Submission 16*, pp 2-3.

5.60 This point was brought home to the committee when it assessed the agricultural sector's awareness of current initiatives as part of a national strategy to assist the agricultural sector to adapt to climate change. Disappointingly, it was predominantly Government and research organisations which demonstrated awareness of these initiatives.

5.61 In its Interim Report, the committee noted the urgent need for improved communication of climate projections to farmers and others in the agricultural sector.[57] The committee concludes that there is a need for improved communication to the agricultural sector which extends beyond the communication of climate change projections to encompass any information which would assist those in the agricultural sector to understand and adapt to climate change.

5.62 The committee is further concerned by other evidence of a lack of communication between Government departments in relation to climate change initiatives. Both the Winemakers' Federation of Australia and the National Farmers' Federation (NFF) noted their membership of the *Greenhouse Challenge Plus* program.[58] This is an initiative of the Department of Environment, Water, Heritage and the Arts which enables 'Australian companies to form working partnerships with the Australian Government to improve energy efficiency and reduce greenhouse gas emissions'.[59] The committee believes that this program could be a very valuable tool for others in the agricultural sector.

5.63 The committee understands that the DAFF/DCC submission was probably not intended to be an exhaustive compilation of all programs currently in place as part of a national strategy to assist the agricultural sector to adapt to climate change. However, the omission of the *Greenhouse Challenge Plus* program from the DAFF/DCC submission could be seen as an example of an issue that Ms Nicolette Boele of the Agricultural Alliance for Climate Change discussed in her evidence:

> …one of the main barriers to action on climate change I see in the agriculture sector has to do with the silos with which the Commonwealth deals with the issue. It is very easy to criticise from where I am sitting but it is a very clear thing. There is a move towards fixing it, but you have DAFF, DCC and other subagencies like [Bureau of Rural Sciences] and [Australian Bureau of Agricultural and Resource Economics] – groups that do not communicate well or have not been told to – who have a focus and boundaries to the work and research that they do.[60]

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57 Interim Report, p. 13.

58 *Submission 22*, p. 1; and *Submission* 24, p. 4.

59 Department of Environment, Water, Heritage and the Arts website, *Greenhouse Challenge Plus*. Available at: http://www.environment.gov.au/settlements/challenge/, accessed 18 November 2008.

60 *Committee Hansard*, 1 July 2008, p. 15-16.

5.64 The committee notes that DAFF is responsible for the development of a national climate change strategy for agriculture. The committee considers therefore that DAFF should prioritise strategic planning for climate change mitigation and adaptation and actively engage in the implementation of the CCRSPI recommendations through the development of advice and programs to the agricultural sector accordingly.

Recommendation 3

5.65 DAFF should prioritise strategic planning for climate change mitigation and adaptation in agriculture and rural communities and play a greater leadership role than is currently the case.

5.66 The committee is also alarmed by the apparent lack of coordination of, and focus to, research projects into the mitigation and adaptation of climate change, particularly those initiated by government. For example, it is not clear to the committee how initiatives such as the Australian Climate Change Science Program fit with the establishment of the Climate Change Research Facility at Griffith University or the CSIRO Flagship on Climate Change Adaptation. The committee agrees with the observations in the Land & Water Australia submission in relation to current research efforts:

> The myriad of uncoordinated and relatively small scale research projects being undertaken involves a significant risk that the research effort will not be maximised, or decrease in priority, as researchers and policy makers attempt to address competing interests and priorities.[61]

5.67 The committee understands that many in the agricultural sector and the research community see CCRSPI as a positive development in this area. However, the committee also notes that CCRSPI is limited by the information it receives from research organisations.

5.68 The committee would urge all involved in climate change research to engage in CCRSPI to ensure that the most benefit is gained from this process.

Senator Glenn Sterle
Chair

61 *Submission* 3, p. 3.

Appendix 1

List of Submissions

1. Mr Nigel Carney

2. Mr Ian Bowie

3. Land & Water Australia

4. Primary Industries and Natural Resources Curriculum Centre TAFE NSW

5. Council of Australasian Weed Societies Inc

6. National Association of Forest Industries

7. Bureau of Meteorology

8. eWater CRC

9. A3P

10. Green Institute

11. Voiceless

12. Hawkesbury Harvest Inc

13. Australian Landcare Council

14. Gwydir Valley Irrigators Association Inc

15. Rural Business Development Corporation

16. CRC National Plant Biosecurity

17. Wentworth Group of Concerned Scientists

18. NSW Irrigators' Council

19. CRC for Australian Weed Management

20. Australian Energy Company Limited

21. The Australian Institute

22. Winemakers' Federation of Australia

23. Apple and Pear Australia Limited

24. National Farmers' Federation

25. Food Industry Council of Tasmania

26. Western Australian Department of Water

27. Victorian Department of Primary Industries

28. Westpac Banking Corporation

29. Grains Research and Development Corporation (GRDC)

30. Queensland Government

31. Growcom

32. CSIRO

33. National Land & Water Resources Audit Advisory Council

34. Department of Agriculture, Fisheries and Forestry and the Department of Climate Change

35. Murray Darling Basin Commission

36. Meat and Livestock Australia & Cattle Council of Australia

37. The Agricultural Alliance on Climate Change

38. Future Farm Industries CRC

39. Sydney Centre for International Law

40. WA No-Tillage Farmers Association

41. Mr Tim Wiley and Mr Bob Wilson

42. Australian Soil Carbon Accreditation Scheme (ASCAS)

42A Australian Soil Carbon Accreditation Scheme (ASCAS

Appendix 2

Witnesses who appeared before the Committee at the Public Hearings

Monday, 30 June 2008
Parliament House
CANBERRA

CSIRO
Dr Mark Howden, Theme Leader, Climate Adaptation Flagship

Bureau of Meteorology
Dr Michael Coughlan, Chief Climatologist
Dr Scott Power, Principal Research Scientist

Mr Tim Wiley (Private capacity)

Mr Robert Wilson (Private capacity)

Australian Soil Carbon Accreditation Scheme
Dr Christine Jones, Founder

Land and Water Australia
Dr Michael Robinson, Executive Director, and Chair, Joint Strategy Team, National Climate Change Research Strategy for Primary Industries
Dr Sam Nelson, Executive Officer, Corporate Strategy

Murray Darling Basin Commission
Mr Jason Alexandra, Director, Water Policy Coordination
Ms Katrina Maguire, Senior Manager, Climate Change Program

Future Farm Industries CRC
Mr Kevin Goss, Chief Executive Officer

CRC for Australian Weed Management
Associate Professor Christopher Preston, Program Leader

National Association of Forest Industries
Mr Allan Hansard, Chief Executive Officer
Mr David de Jongh, Senior Forest Policy Analyst

The Green Institute
Ms Margaret Blakers, Coordinator

Tuesday, 1 July 2008
Parliament House
CANBERRA

Meat and Livestock Australia
Dr Beverly Henry, Manager Environment, Sustainability and Climate Change
Dr Ian Johnsson, General Manager, Livestock Production Innovation

Cattle Council of Australia
Mr Greg Brown, Acting President
Mr David Inall, Executive Director
Mr Jed Matz, Policy Director
Mr Hamish Munro, Councillor (NSW)

The Agricultural Alliance on Climate Change
Ms Nicolette Boele, Director, Strategic Projects

National Farmers Federation
Mr Ben Fargher, Chief Executive Officer
Mr Charles McElhone, Manager, Economics
Ms Deborah Kerr, Natural Resource Management

Wentworth Group of Concerned Scientists
Professor Michael Young, Research Chair, Water Economics and Management

Department of Water Western Australia
Mr John Ruprecht, Director, Water Resource Management

Department of Primary Industries and Fisheries, Queensland
Mr Jim Groves, General Manager, Climate and Resource Policy
Ms Marion Murphy, Senior Policy Officer, Climate and Resource Policy

Department of Primary Industries, Victoria
Mr Andrew Dolling, Director, Climate Change in Agriculture, Agriculture and Natural Resources Policy Branch

Department of Agriculture, Fisheries and Forestry and the Department of Climate Change
Mr Ian Carruthers, First Assistant Secretary, Adaptation and Land Management Division
Mr David Mortimer, Executive Manager, Climate Change Division
Dr Colin Grant, Executive Director, Bureau of Rural Sciences
Dr Don Gunasekera, Chief Economist, Australian Bureau of Agricultural Resource Economics
Mr Mark Gibbs, General Manger, Climate Change Policy
Ms Desley Darby, Acting Manager, Drought and Exceptional Circumstances
Dr John Sims, Program Leader, Bureau of Rural Sciences